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ABSTRACT

This booklet contains games and activities that can be photocopied for classroom use. Activities include Wetland Terminology, Putting on the Map, Erosional Forces, Water in...Water out, Who Lives Here?, Wetlands in Disguise, Dichotomous Plant Game, Algae Survey, Conducting an Algal Survey, Water Quality Indicators Guide, Farming Wetlands, Wetlands Jeopardy, and Wetland Hop. (JRH)

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ED 399 137

North Dakota Wetlands Discovery Guide

Photocopy Booklet

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NORTH DAKOTA WETLANDS DISCOVERY GUIDE
Photocopy Booklet

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WETLAND TERMINOLOGY

North Dakota Wetlands Word Search
Student Page

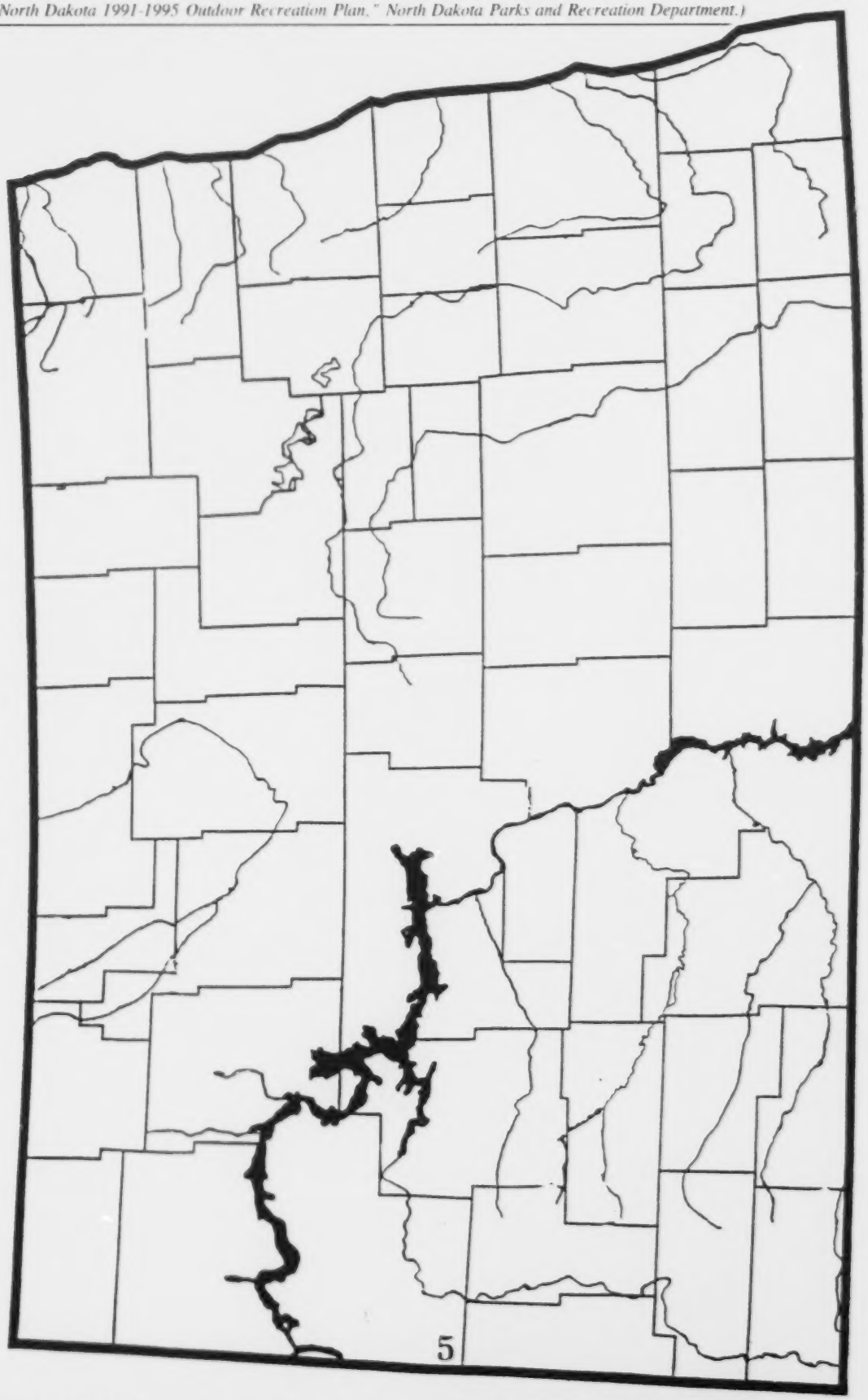
Words appear UP, DOWN, BACKWARDS, and DIAGONALLY. Find and circle each word. Use the remaining letters to solve the mystery sentence below.

R S P H Y D R I C S O I L S
I L U T E M P O R A R Y D C
P O D E P R E S S I O N S A
A U D G R O U N D W A T E R
R G L A C I E R S L L H M S
I H E E H W N E T T W Y I L
A S S S N A N E D F O D P P
N S R P R I W O F L F R E E
C A T T A I L O V O R O R R
M S E A S O N A L O E P M M
D I B L D U E F S D T H A A
N O O A R P M A W S A Y N N
O R G K S H A L L O W T E E
P T L E M W O N S U S I N N
A L L S E L O H T O P C T T

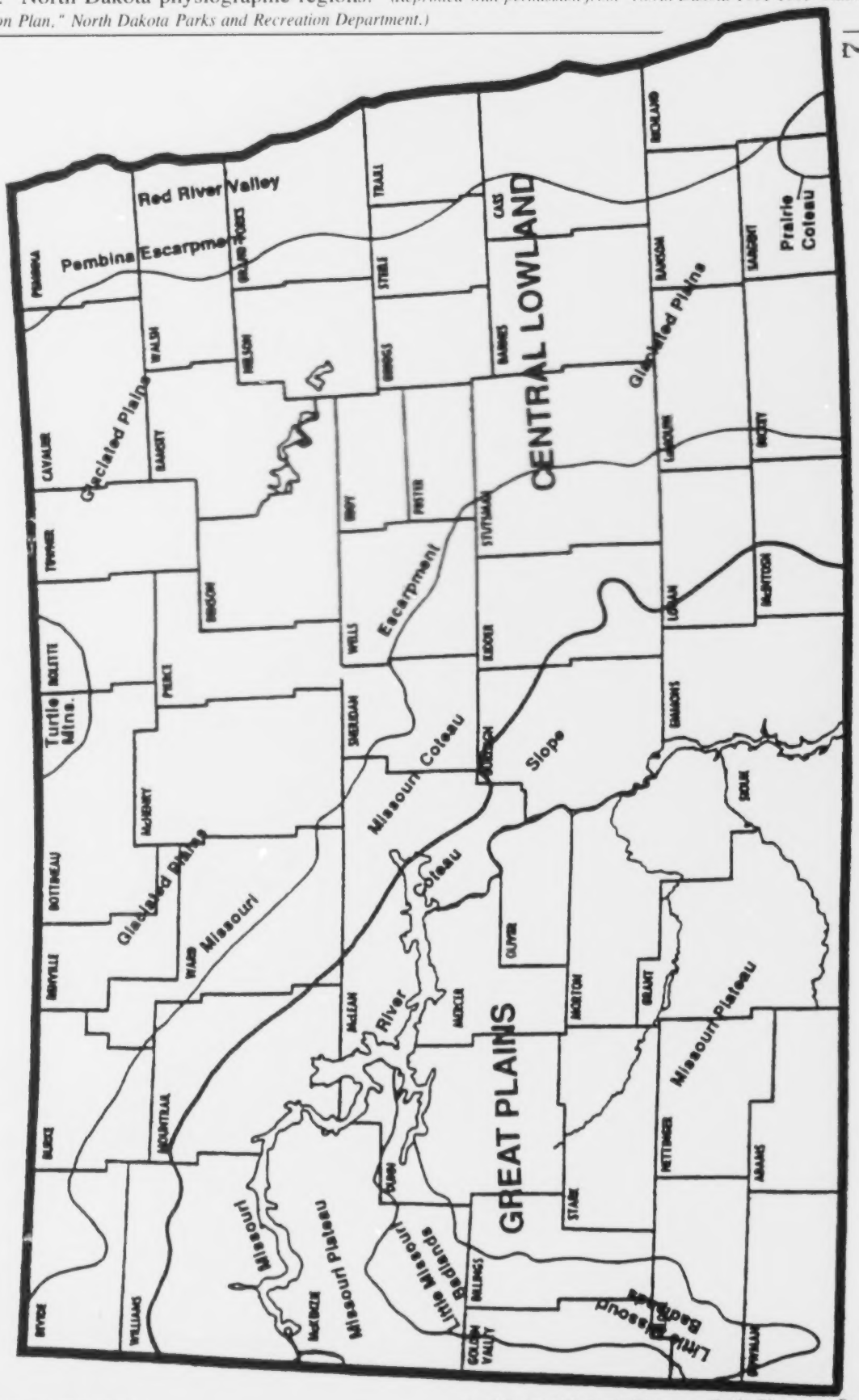
* _____	* _____	* _____
* _____	* _____	* _____
* _____	* _____	* _____
* _____	* _____	* _____
* _____	* _____	* _____
* _____	* _____	* _____
* _____	* _____	* _____
* _____	* _____	* _____
* _____	* _____	* _____
* _____	* _____	* _____
* _____		

_ _ _ _

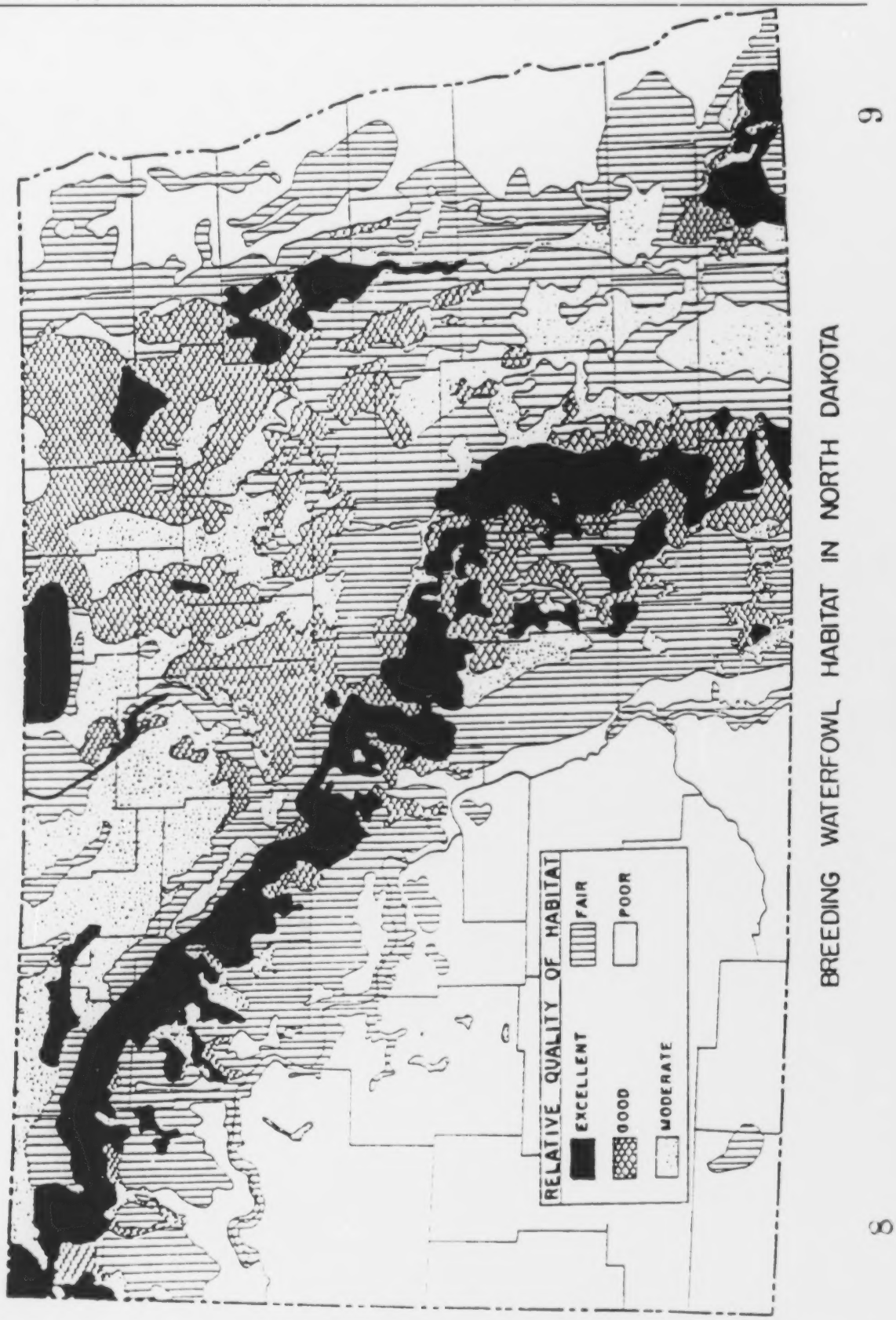
Map 1. General outline map of North Dakota with major geographic features. *(Reprinted with permission from "North Dakota 1991-1995 Outdoor Recreation Plan," North Dakota Parks and Recreation Department.)*



Map 2. North Dakota physiographic regions. *(Reprinted with permission from "North Dakota 1991-1995 Outdoor Recreation Plan," North Dakota Parks and Recreation Department.)*

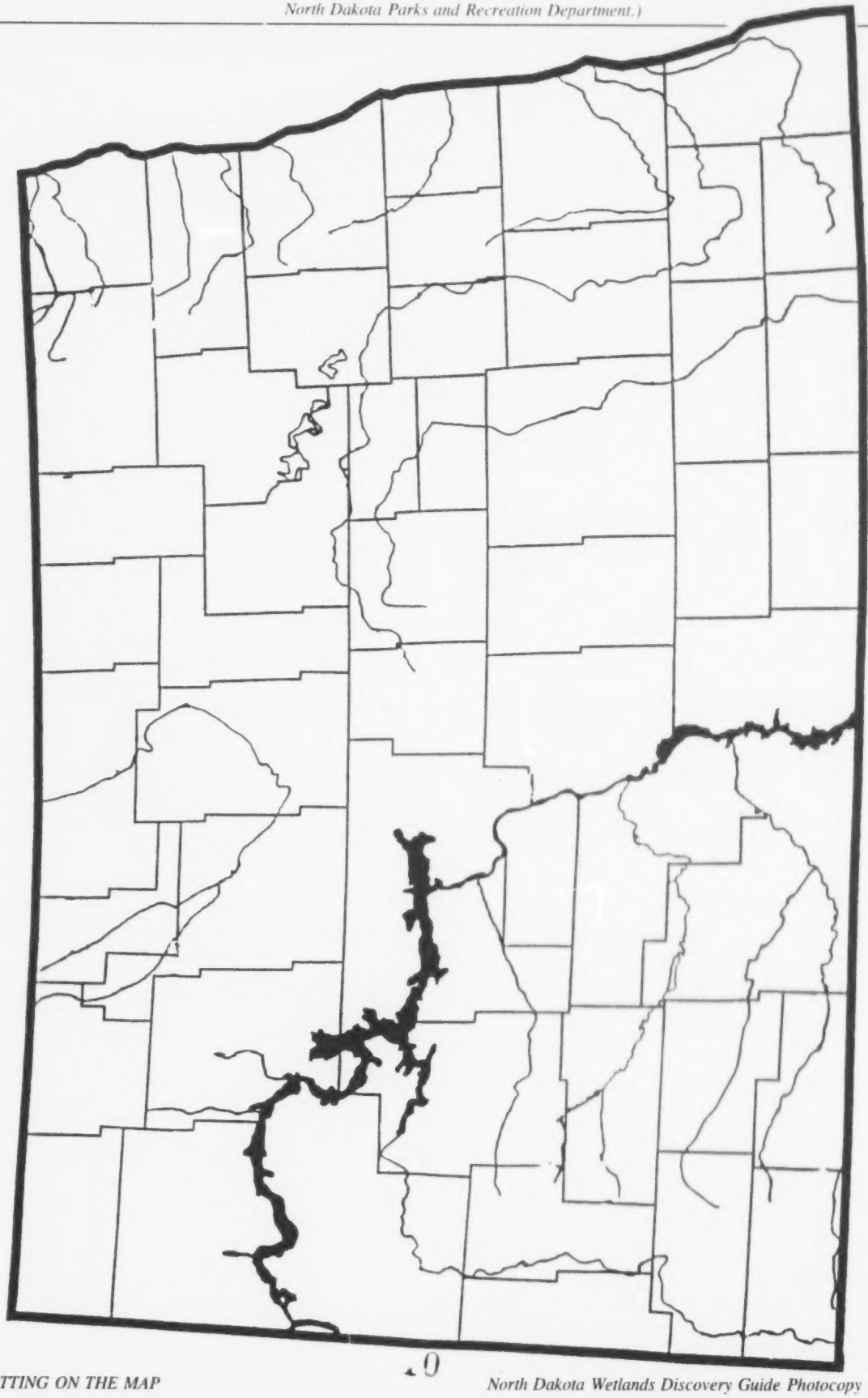


Map 3. Current quality of wetland habitat of North Dakota. *(Map prepared by H.A. Kantrud and R.E. Stewart; map provided courtesy of Northern Prairie Wildlife Research Center, National Biological Service, Jamestown, North Dakota.)*



STUDENT PAGE

(Reprinted with permission from "North Dakota 1991-1995 Outdoor Recreation Plan," North Dakota Parks and Recreation Department.)



EROSIONAL FORCES

STUDENT OBSERVATION PAGE

SOIL TYPE #1 = _____

Precipitation Event	Amount of Soil Erosion/Time				
	Without Grass Buffer	With Grass Buffer Strip			Human Intervention
		Week 1	Week 2	Week 3	
#1					
#2					
#3					

SOIL TYPE #2 = _____

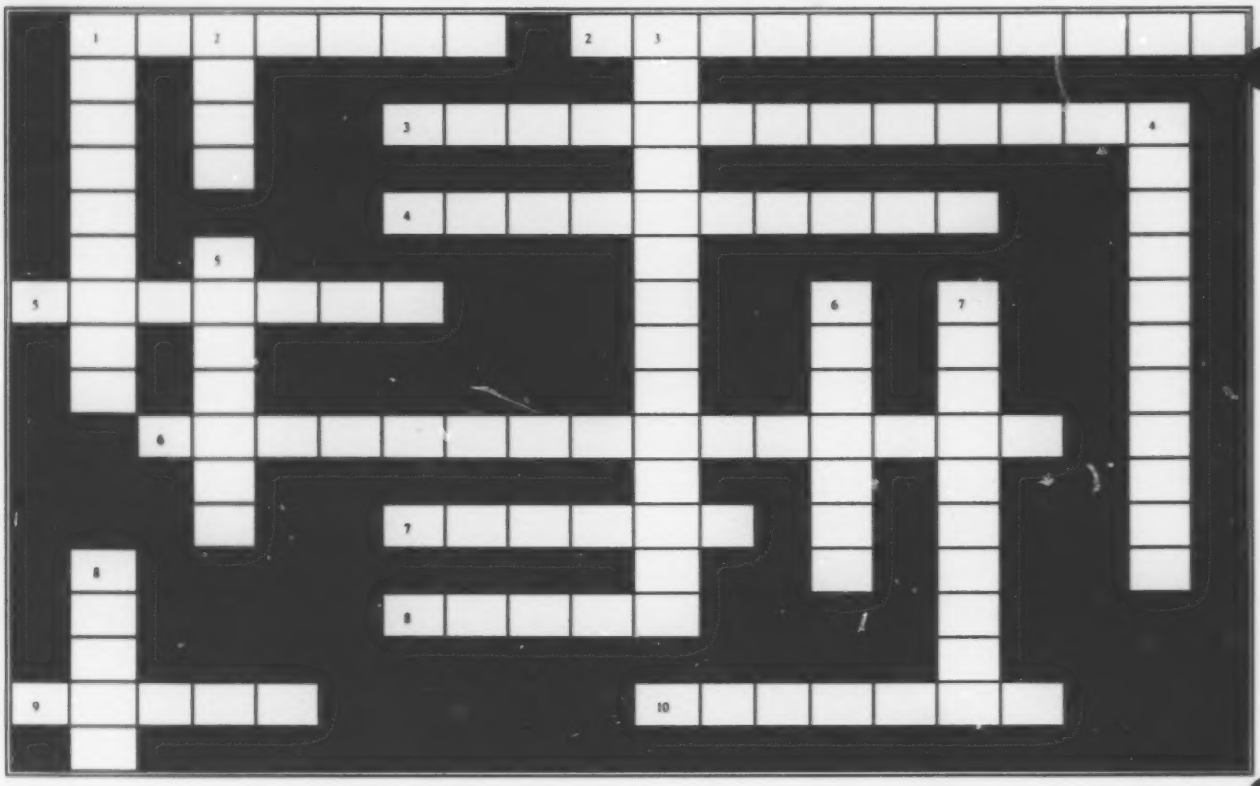
Precipitation Event	Amount of Soil Erosion/Time				
	Without Grass Buffer	With Grass Buffer Strip			Human Intervention
		Week 1	Week 2	Week 3	
#1					
#2					
#3					

SOIL TYPE #3 = _____

Precipitation Event	Amount of Soil Erosion/Time				
	Without Grass Buffer	With Grass Buffer Strip			Human Intervention
		Week 1	Week 2	Week 3	
#1					
#2					
#3					

WATER IN ... WATER OUT ...

CROSSWORD PUZZLE



ACROSS

[1] Wetlands are _____ systems which can treat pollutants and waste.

[2] Process by which a substance changes from a liquid to a gas by exposure to the air or heat.

[3] Method by which water vapor is released from the surface of the plant to the atmosphere.

[4] Harmful chemicals or waste materials (plural).

[5] Structure of a plant or animal.

[6] Upward movement of water through a plant (two words).

[7] They have stems, roots, and leaves (plural).

[8] Tissue that transports water and dissolved minerals upward through a plant.

[9] A necessary component for all life.

[10] Functions naturally as a filter of pollutants and waste water.

DOWN

[1] Elements required by organisms for growth and reproduction.

[2] Wetland plants do this to particles of sediment, in their stems leaves and roots.

[3] A set of vessels that function as transportation of plant or animal fluids (two words).

[4] State in the Northern Great Plains where about 2.5 million acres of prairie wetlands remain.

[5] Small pores in the epidermis of a leaf or stem through which gas and water vapor pass (plural).

[6] Method by which clean water results as it passes through the wetland.

[7] Process by which water and ions are moved into a plant root.

[8] Wetland plants are efficient at keeping nutrients and pollutants within the wetland and passing along _____ water.

WHO LIVES HERE?

STUDENT DATA PAGE

LOCATION OF WATER SAMPLE	TIME OF DAY TAKEN	AMT. OF SALT	AGITATION TIME	WATER TEMPERATURE		pH		DISSOLVED OXYGEN (ppm)		LIST ORGANISMS EXPECTED TO FIND
				Prediction	Actual	Prediction	Actual	Prediction	Actual	

Tables of pH and dissolved oxygen ranges that support aquatic life.

ORGANISM	pH RANGES Most Acid — Neutral — Most Alkaline 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Bacteria	1.0----------													13.0
Plants (algae, rooted, etc.)						6.5----------								12.0
Carp, suckers, catfish						6.0----------				9.0				
Northern Pike						6.5----------			8.5					
Caddisfly						6.3----------			8.8					
Mayflies						6.0----------			8.8					
Damselflies							8.4-8.6							
Water Strider				4.4----------				8.4						
Giant Water Bugs					5.6----------			8.8						
Predacious Diving Beetle			3.0----------					8.8						
Snails, clams, mussels							7.0----------		9.0					
Water Boatman				3.3----------				8.5						

ORGANISM	DISSOLVED OXYGEN (parts per million or milligrams per liter) 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Caddisfly		2.0----------												14.0
Mayflies, and Whirligig Beetle		2.0----------												14.0
Dragonflies							7.0----------				11.0			
Damselflies	1.0----------								9.0					
Water Strider			3.0----------							10.0				
Water Bugs			3.0----------							10.0				
Predacious Diving Beetle, and other Water Beetles			3.0----------											14.0
Back Swimmer			3.0---4.0											

WETLANDS IN DISGUISE

STUDENT WORK PAGE

CAN YOU FIND A:

LIST OF OBJECTS OR PREY TO BE FOUND	WHERE DID YOU FIND THE OBJECT OR PREY?

SPIKE RUSH

BULRUSH

START OVER

Stem not round or with edges
Stem is round, no edges, spikelet
Stem is round or has edges, several seed heads
Plant does not have hollow-jointed stem

WHITETOP GRASS

Leaves stick out, seed head bushy

Plant is a grass (has a hollow jointed stem)

Long leaves grow above water, seeds droopy

Plant is a grass or grass-like

WILD RICE

START

Game Board lower left piece.

All or most eaves basal
Feather-like leaves in a whorl
Leaves are not basal
Plant not grass-like, soft flowering plant
Leaves clasped around stem

WATER MILFOIL

CLASPING-LEAF PONDWEED

Game Board lower right piece.

Game Board upper right piece.

Game Card - sheet 1 *(Adapted with permission from "Marsh World," Ducks Unlimited Canada)*

WHITETOP GRASS (*Scolocholoa festucacea*)

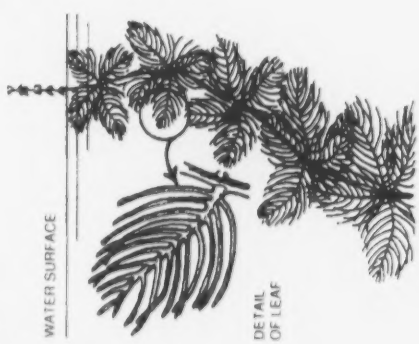
A wetland grass, growing in up to 20 cm of water and reaching a height of 30 to 60 cm. Often found in very dense stands along wetland edges. Not rated as a high duck food, but valuable as nesting cover, shelter for broods and for hay production.

SPIKE RUSH (*Eleocharis macrostachya*)

A common plant bordering wetlands and sloughs in wet mud, it also grows abundantly in shallow water. Characterized by a tapering leafless, unjointed stem which terminates in a single spike. The seeds are tiny, but together with the tubers and rootstock, are valuable duck food.

WATER MILFOIL (*Myriophyllum exalbescens*)

One of the most abundant and widespread of its kind. Leaves are whorled in 4's and 5's, highly dissected into thread-like divisions in a feather-like shape. Though rated a fairly important duck food, its real value is the environment it creates for minute aquatic animals and insect life, which are food for waterfowl and fish.

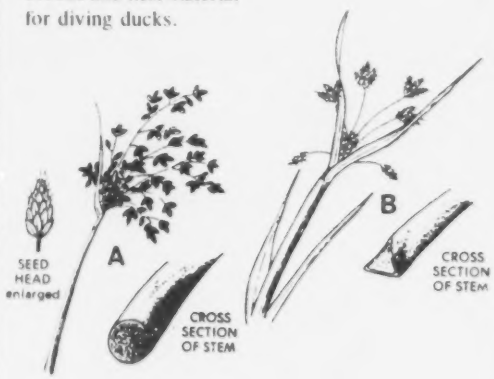


BULRUSH (*Scirpus sp.*)

There are two varieties of this plant.

This variety grows along marsh and stream borders in dense stands and reaching 2.5 meters in height with a stem 20 mm thick. It grows in water depths of up to 5 feet. The seeds are excellent duck food; the rootstock are eaten by geese. This plant provides good cover for broods and nest material for diving ducks.

This variety grows to a height of 60 cm along muddy stretches of river and particularly alkaline wetlands. It grows in water depths of up to 2.5 feet. The seeds are also eaten by waterfowl. Flowers from July to September.

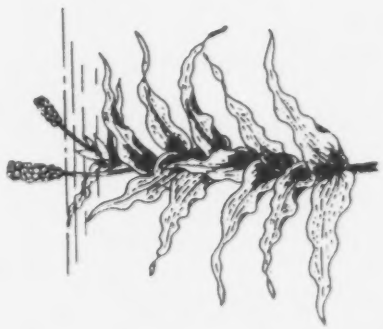


ARROWHEAD (*Sagittaria cuneata*)

These plants grow in shallow water or mud and are easily identified. It has white 3-petaled flowers, that blossom in July and August. The flowers are medium-sized on a single stalk. The plants tubers, called duck potatoes, are eaten by ducks which root them from soft mud. They eat the fleshy basal portions.

CLASPING-LEAF PONDWEED (*Potamogeton richardsonii*)

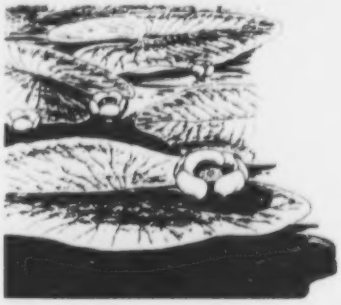
A valuable waterfowl food plant; seeds, leaves and rootstock are eaten. The plant is submersed with only the flower spike above water. Abundant in freshwater wetlands and in water with a salinity up to 25%. Found throughout North Dakota and the Prairie Pothole Region.



Game Card - sheet 3 *(Adapted with permission from "Marsh World," Ducks Unlimited Canada)*

YELLOW WATER LILY (*Nuphar luteum*)

A perennial aquatic plant, this plant is found throughout temperate North America in fresh and acid ponds, wetlands and slow streams of moderate depth. Large, attractive oblong leaves measuring 15 x 25 cm, float on the water surface. The flowers are bright yellow and about 5 cm across. Rootstocks are eaten by moose and the seeds by waterfowl, particularly the ring-necked duck. These plants are often so abundant that they cover the surface of creeks or small ponds. It flowers from June to September.



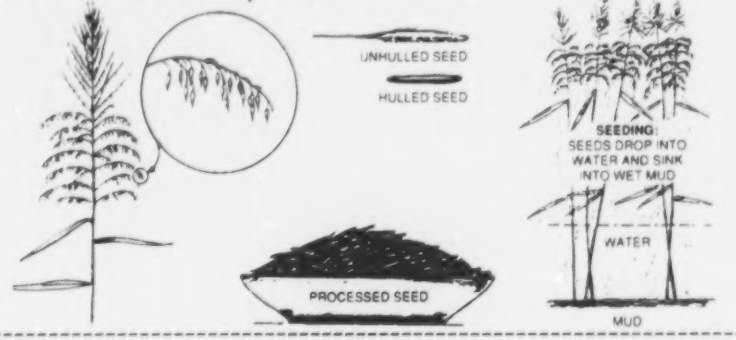
FLOWER CLOSE-UP WITH SEPALS SPREAD TO SHOW GEOMETRIC DESIGN OF CENTRE

WATER PLANTAIN (*Alisma plantago*)

These plants grow in shallow water or mud and are easily identified. It has white 3-petaled flowers. The flowers are tiny and on a many-branched stalk. It is a good food for geese. They eat the fleshy basal portions. Occurs throughout North Dakota.

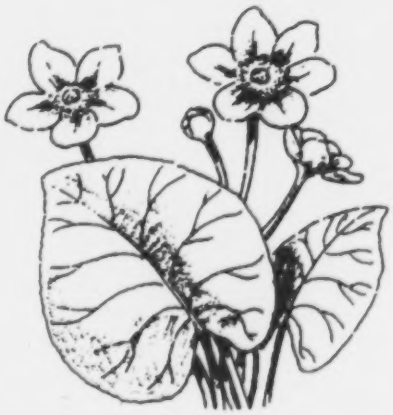
WILD RICE (*Zizania aquatica*)

This annual grass is a very important duck-food. Except for a few isolated records, it is confined to the eastern half of North Dakota. It grows best in 2 feet or less water, and reaches a height of 3 meters. Processed, the long black grains make an excellent and highly nutritious cooked cereal. It flowers from June to September.



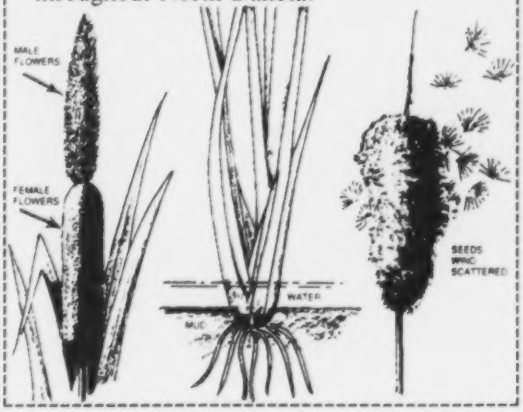
MARSH MARIGOLD (*Caltha palustris*)

A member of the buttercup family, this low compact plant has broad, heart-shaped leaves with thick hollow stems. Flowers are deep yellow and consist of 5 to 9 petals (actually sepals). Flowers from April to May. Found primarily in eastern North Dakota.



CATTAIL (*Typha sp.*)

There are two species of this common wetland plant. This plant grows in shallow water in dense beds and up to 2 meters in height, frequently colonizing entire wetlands. Rootstock are a valuable food for muskrats which also use the stems and leaves as building material for their houses. It is occasionally useful as goose forage. It also provides excellent cover for many species of waterfowl and other wetland birds. Marsh wrens and blackbirds build their nests in these plants. Flowers in May and June. Occurs throughout North Dakota.



ALGAE SURVEY STUDENT ACTIVITY PAGE

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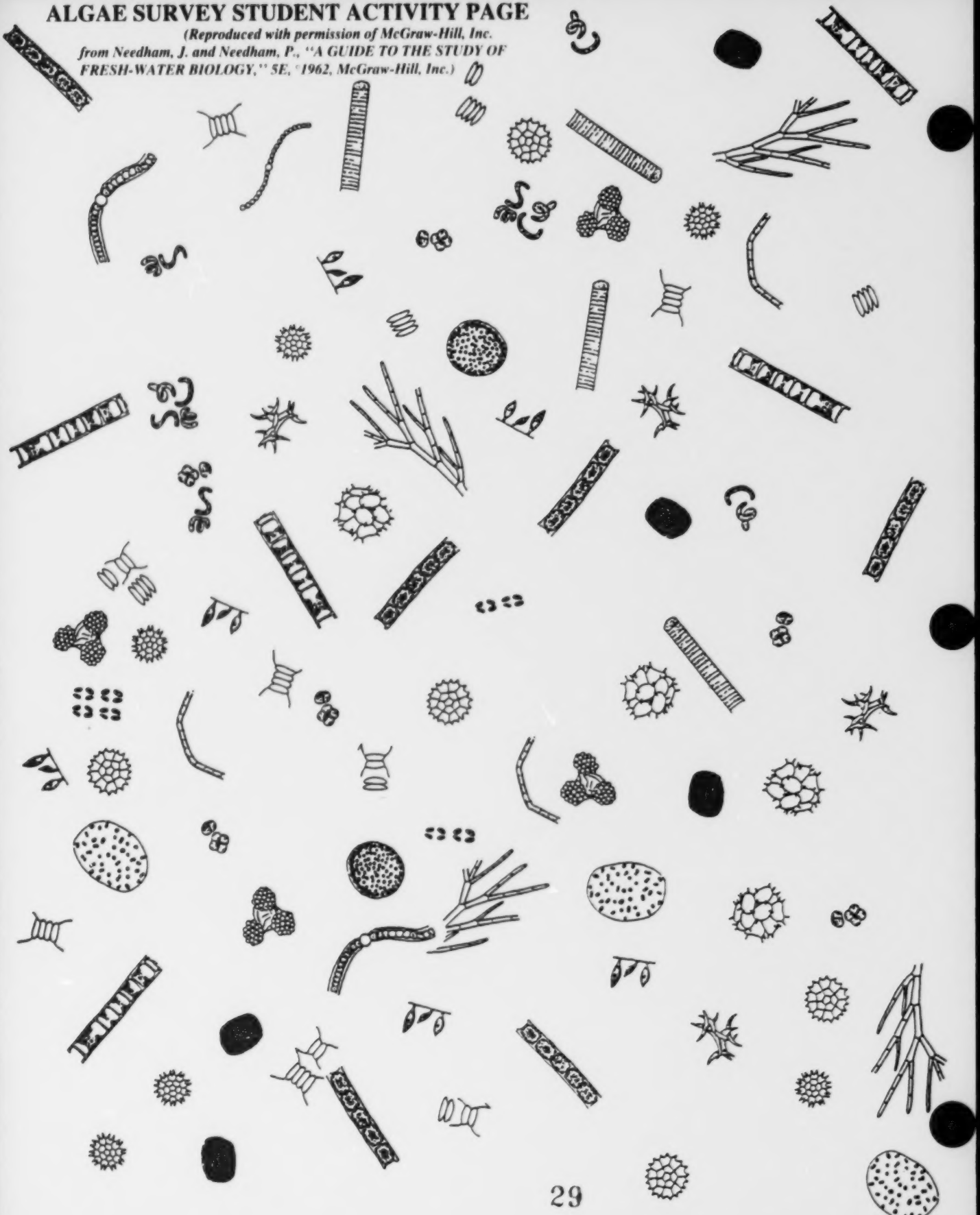
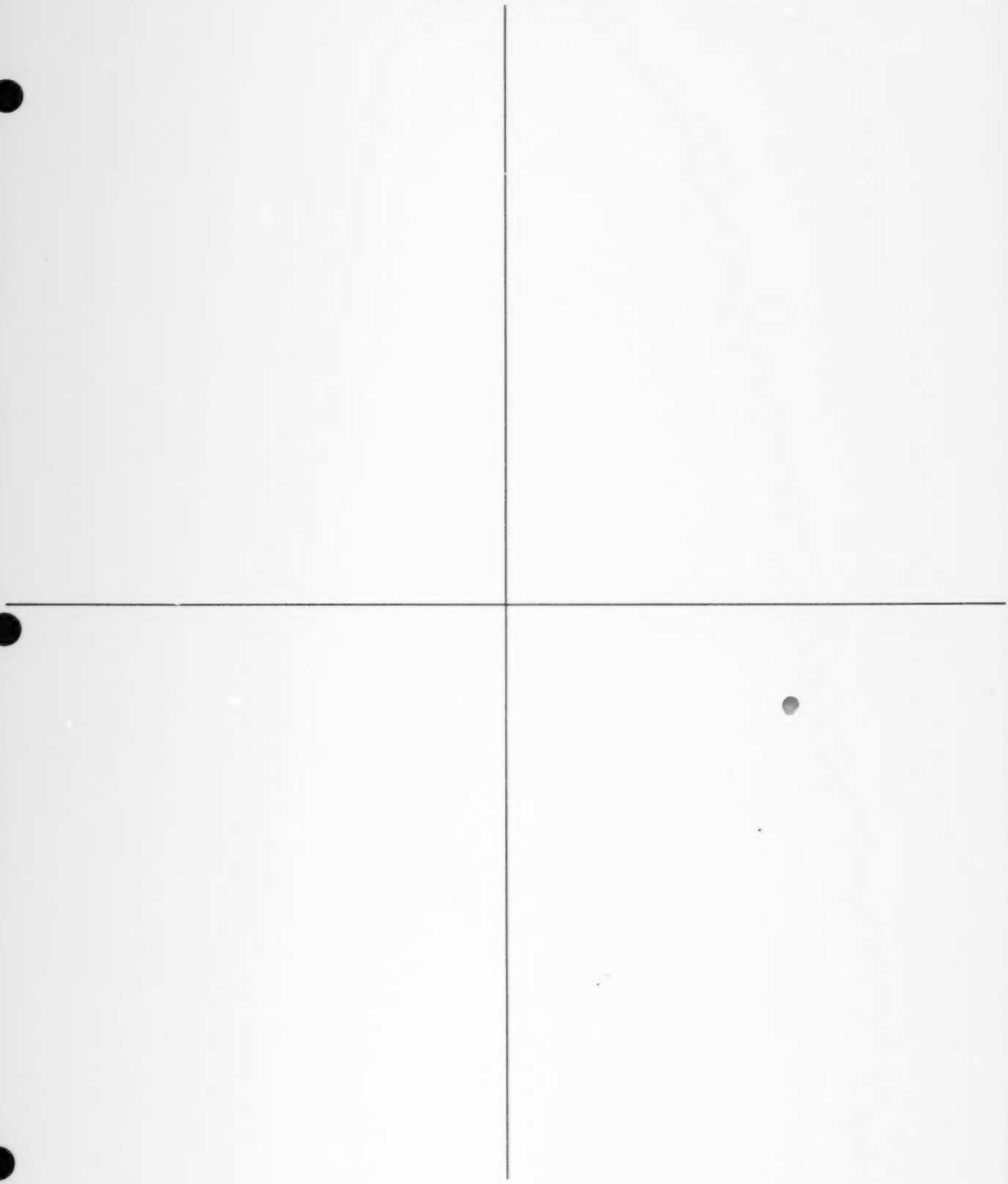


GRID OVERLAY



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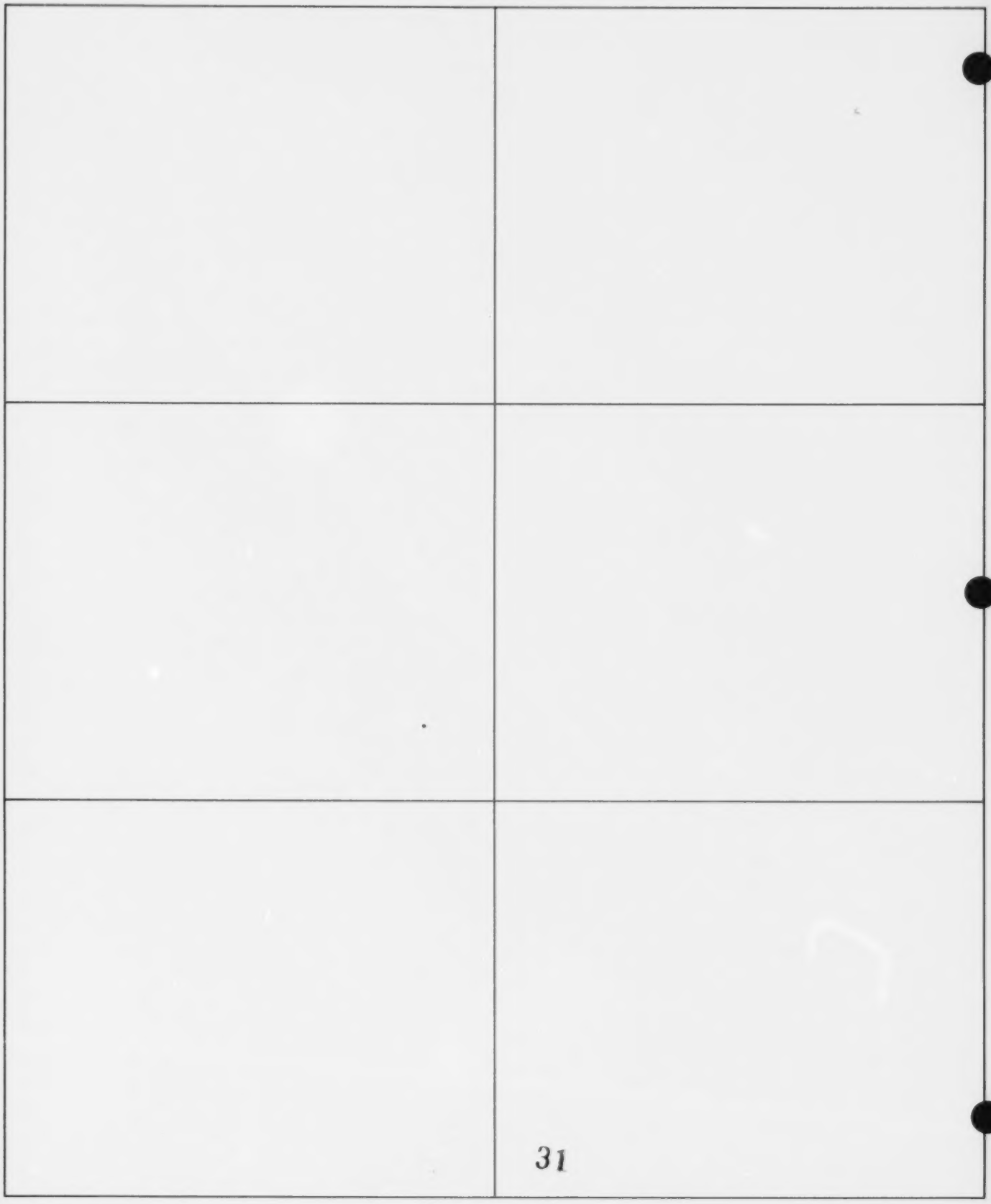

ALGAE IDENTIFICATION KEY

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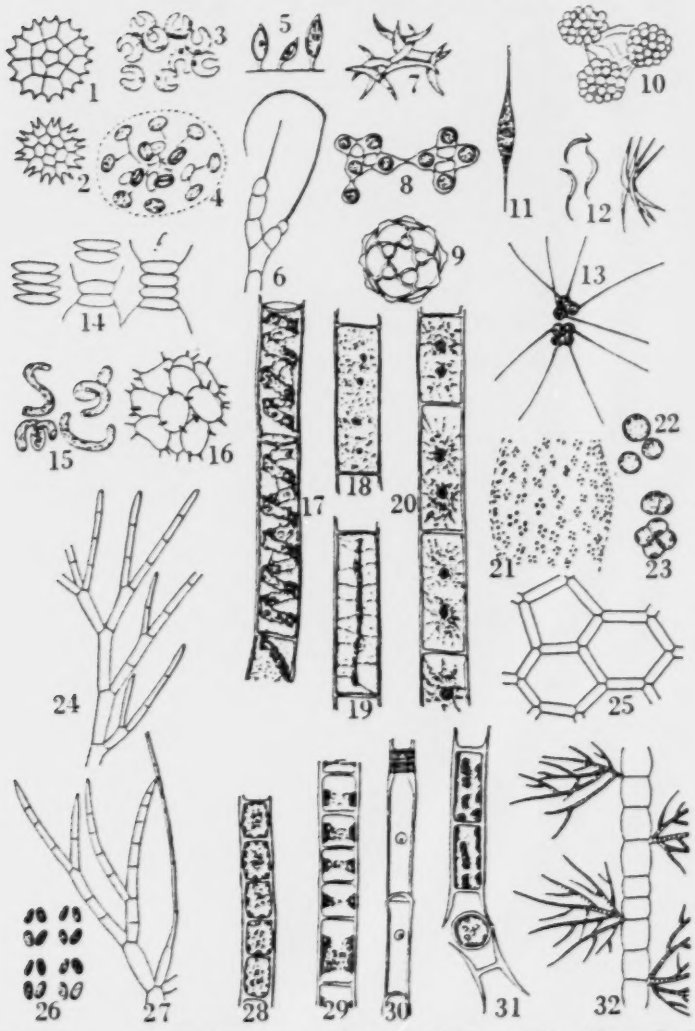
GREEN ALGAE

PLATE IB: GREEN ALGAE



1, 2. Pediastrum
3. Kirchneriella
4. Dictyosphaerium
5. Characium
6. Bulbochaete
7. Selenastrum
8, 9. Coelastrum
10. Botryococcus
11, 12. Ankistrodesmus
13. Richterella
14. Scenedesmus
15. Ophiocytium
16. Sorastrum
17. Spirogyra
18, 19. Mougeotia
20. Zygnema
21. Tetraspora
22, 23. Protococcus
24. Cladophora
25. Hydrodictyon
26. Crucigenia
27. Chaetophora
28. Microspora
29. Ulothrix
30. Oedogonium
31. Tribonema
32. Draparnaldia

Ankistrodesmus, 11, 12
Botryococcus, 10
Bulbochaete, 6
Characium, 5
Chaetophora, 27
Cladophora, 24
Coelastrum, 8, 9
Crucigenia, 26
Dictyosphaerium, 4
Draparnaldia, 32
Hydrodictyon, 25
Kirchneriella, 3
Microspora, 28
Mougeotia, 18, 19
Oedogonium, 30
Ophiocytium, 15
Protococcus, 22, 23
Pediastrum, 1, 2
Richterella, 13
Scenedesmus, 14
Selenastrum, 7
Sorastrum, 16
Spirogyra, 17
Tribonema, 31
Ulothrix, 29
Zygnema, 20

ALGAE IDENTIFICATION KEY

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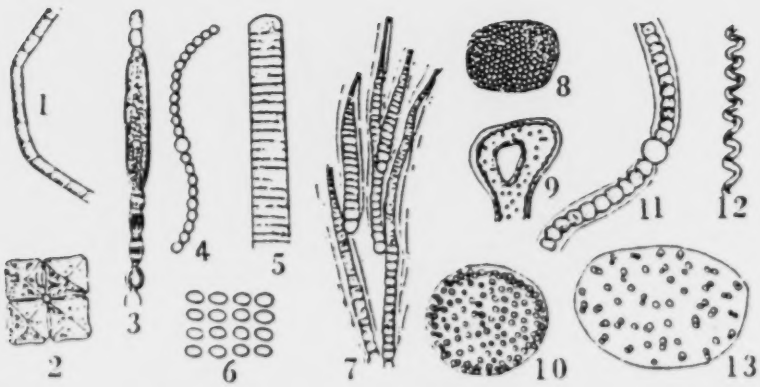
BLUE-GREEN ALGAE

PLATE IA: BLUE-GREEN ALGAE



1. Phormidium
2. Tetrapedia
3. Aphanizomenon
4. Anabaena
5. Oscillatoria
6. Merismopedia
7. Rivularia
8, 9. Polycystis
10. Coelosphaerium
11. Nostoc
12. Spirulina
13. Aphanocapsa

Anabaena, 4
Aphanocapsa, 13
Aphanizomen, 3
Coelosphaerium, 10
Merismopedia, 6
Polycysus, 8, 9
Nostoc, 11
Oscillatoria, 5
Phormidium, 1
Rivularia, 7
Spirulina, 12
Tetrapedia, 2

COMMON FRESHWATER ALGAE IN NORTH DAKOTA WETLANDS[a]

Algae Type	Algae Scientific Name	Appendix Figure Reference[b]
Phytoplankton (Algae suspended in the water column.)	*Anabaena planctonica*	B-1
	Anacystis dimidiata	B-2
	Anacystis montana	B-3
	Ankistrodesmus falcatus	B-4
	Chlamydomonos sp.	B-3
	Chlorococcum humicola	B-3
	Coelastrum microporum	B-5
	Eudorina elegans	B-5
	Navicula graciloides	B-2
	Navicula gracilis	B-4
	Nodularia spumigena	B-5
	Oscillatoria chalybea	B-2
	Oscillatoria chorina	B-3
	Oscillatoria princeps	B-2
	Oscillatoria splendida	B-2
	Rhodomonas lacustris	B-4
	Sphaerocystis schroeteri	B-5
Metaphyton[c] (Floating Algae)	*Aphanizomenon flos-aquae*	B-1
	Actinastrum gracillimum	B-5
	Carteria multifilis	B-3
	Chlorogonium euchlorum	B-3
	Lyngbya lagerheimii	B-6
	Microspora amoena	B-6
	Mougeotia scalaris	B-5
	Oedogonium suecicum	B-6
	Pediastrum boryanum	B-5
	Pyrobotrys stellata	B-3
	Scenedesmus quadricauda	B-5
	Spriogyra communis	B-3
	Spriogyra porticalis	B-2
	Ulothrix aequalis	B-4
	Zygnema sterile	B-5
Periphyton (Algae growing in or attached to bottom sediments, or growing on plants.)	*Anabaena spp.*	B-1
	Chlamydomonas sp.	B-3
	Chlorella pyrenoidosa	B-2
	Chlorococcum humicola	B-3
	Cladophora glomerata	B-4
	Cladophora crispata	B-6
	Cocconeis placentula	B-4
	Gomphonema parvulum	B-3
	Gomphonema geminatum	B-6
	Navicula graciloides	B-2
	Navicula gracilis	B-4
	Oedogonium suecicum	B-6
	Oscillatoria spp.	B-2, B-3
	Phormidium autumnale	B-3
	Phormidium uncinatum	B-6
	Ulothrix zonata	B-6

[a] From Kantrud, Krapu and Swanson (1989), van der Valk (1989), and Terrell and Bytnar Perfetti (1989).

[b] See the Appendix B reprint from the Soil Conservation Service "Water Quality Indicators Guide: Surface Waters" found in the Photocopy Booklet.

[c] Metaphyton assemblage may also include a variety of phytoplankton and periphyton algae that becomes entangled in the filamentous mass.

APPENDIX B

Aquatic Organisms

Algae Important in Water Supplies (ref. B-1).

- Taste and odor algae
- Filter clogging algae
- Polluted water algae
- Clean water algae
- Plankton and other surface water algae
- Algae growing on reservoir walls

Types of Freshwater Algae (ref. B-2).

Simple Assessment of Bottom-Dwelling Insects (ref. A-2).

SCS Key to the Major Invertebrate Species of Stream Zones (ref. B-3).

Diagrams of Common Fish Species (ref. B-4).

Detection of *Escherichia coli* in water samples (ref. B-5).

Table B-1.—Taste and odor algae.

Species Names	Linear Magnifications
Anabaena plactonica	250
Anacystis cyanea	250
Aphanizomenon flos-aquae	250
Asterionella gracillima	250
Ceratium hirundinella	250
Dinobryon divergens	250
Gomphosphaeria lacustris, kuetzingianum type	500
Hydrodictyon reticulatum	10
Mallomonas caudata	500
Nitella gracilis	1
Pandorina morum	500
Peridinium cinctum	500
Staurastrum paradoxum	500
Synedra ulna	250
Synura uvella	500
Tabellaria fenestrata	250
Uroglenopsis americana	125
Volvox aureus	125

Table B-2.—Filter clogging algae

Species Names	Linear Magnifications
Anabaena flos-aquae	500
Anacystis dimidiata	1000
Asterionella formosa	1000
Chlorella pyrenoidosa	5000
Closterium moniliferum	250
Cyclotella meneghiniana	1500
Cymbella ventricosa	1500
Diatoma vulgare	1500
Dinobryon sertularia	1500
Fragilaria crotonensis	1000
Melosira granulata	1000
Navicula graciloides	1500
Oscillatoria princeps (top)	250
Oscillatoria chalybea (middle)	250
Oscillatoria splendida (bottom)	500
Palmella mucosa	1000
Rivularia dura	250
Spirogyra porticalis	125
Synedra acus	500
Tabellaria flocculosa	1500
Trachelomonas crebea	1500
Tribonema bombycinum	500

Table B-3.—Polluted water algae.

Species Names	Linear Magnifications
Agmenellum quadriduplicatum, tenuissima type	1000
Anabaena constricta	500
Anacystis montana	1000
Arthrospira jenneri	1000
Carteria multifilis	2000
Chlamydomonas reinhardi	1500
Chlorella vulgaris	2000
Chlorococcum humicola	1000
Chlorogonium euchlorum	1500
Euglena viridis	1000
Gomphonema parvulum	3000
Lepocinclis texta	500
Lyngbya digueti	1000
Nitzschia palea	2000
Oscillatoria chlorina (top)	1000
Oscillatoria putrida (middle)	1000
Oscillatoria lauterbornii (bottom)	1000
Phacus pyrum	1500
Phormidium autumnale	500
Pyrobotrys stellata	1500
Spirogyra communis	250
Stigeoclonium tenue	500
Tetraedron muticum	1500

Figure B-1

Algae Important in Water Supplies.

Taste and Odor Algae

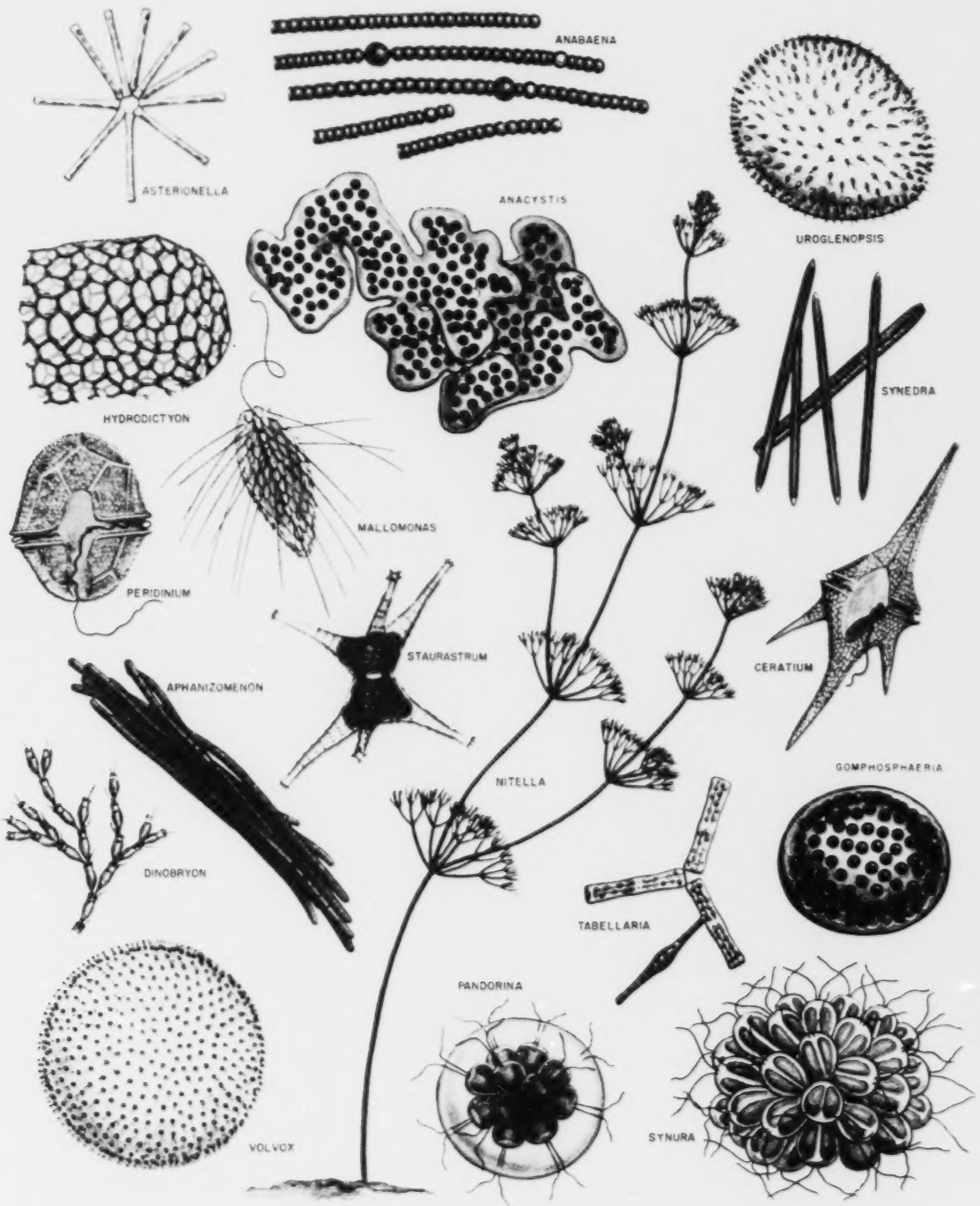


Figure B-2

Filter Clogging Algae.

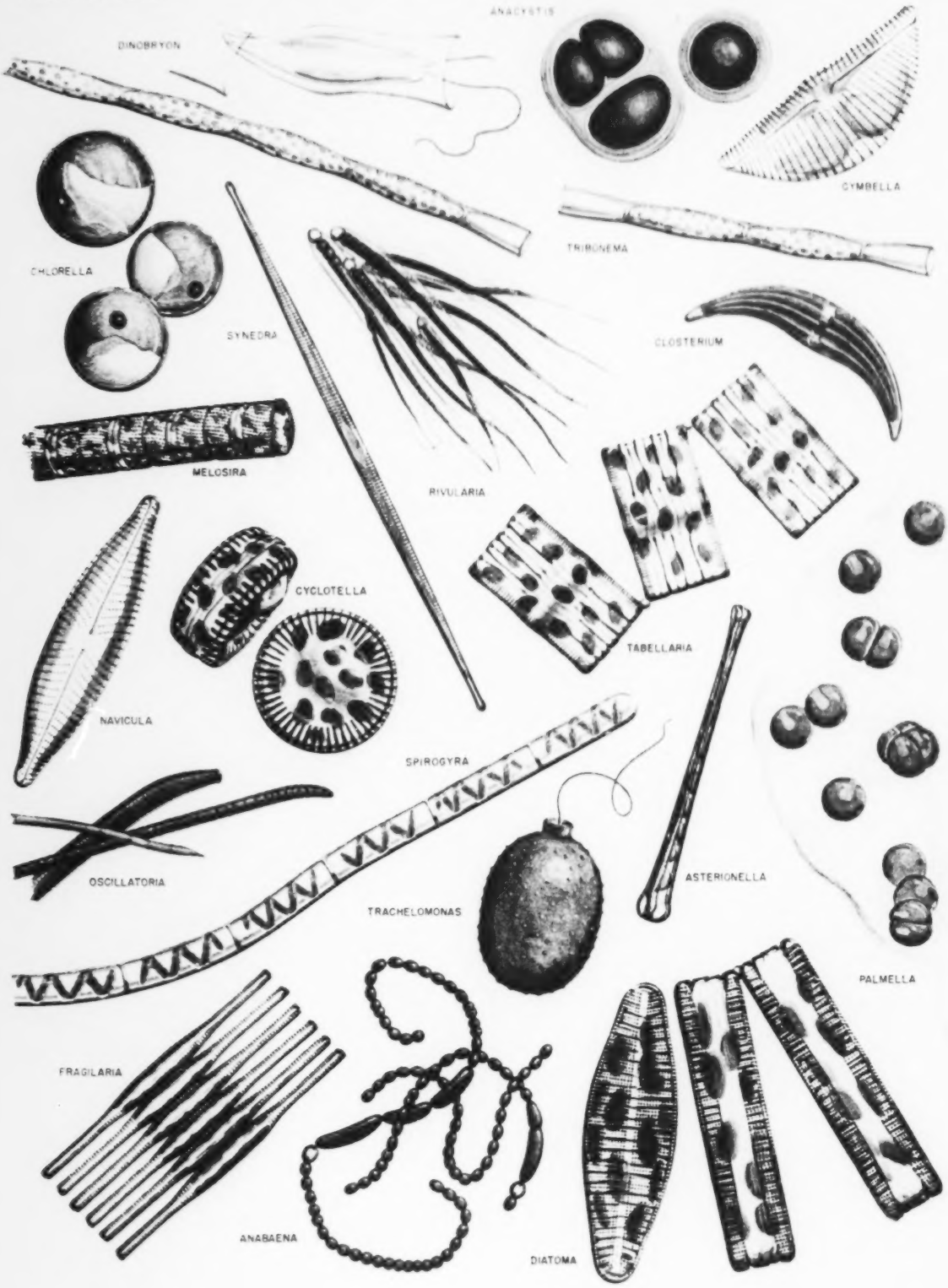


Figure B-3

Polluted Water Algae.

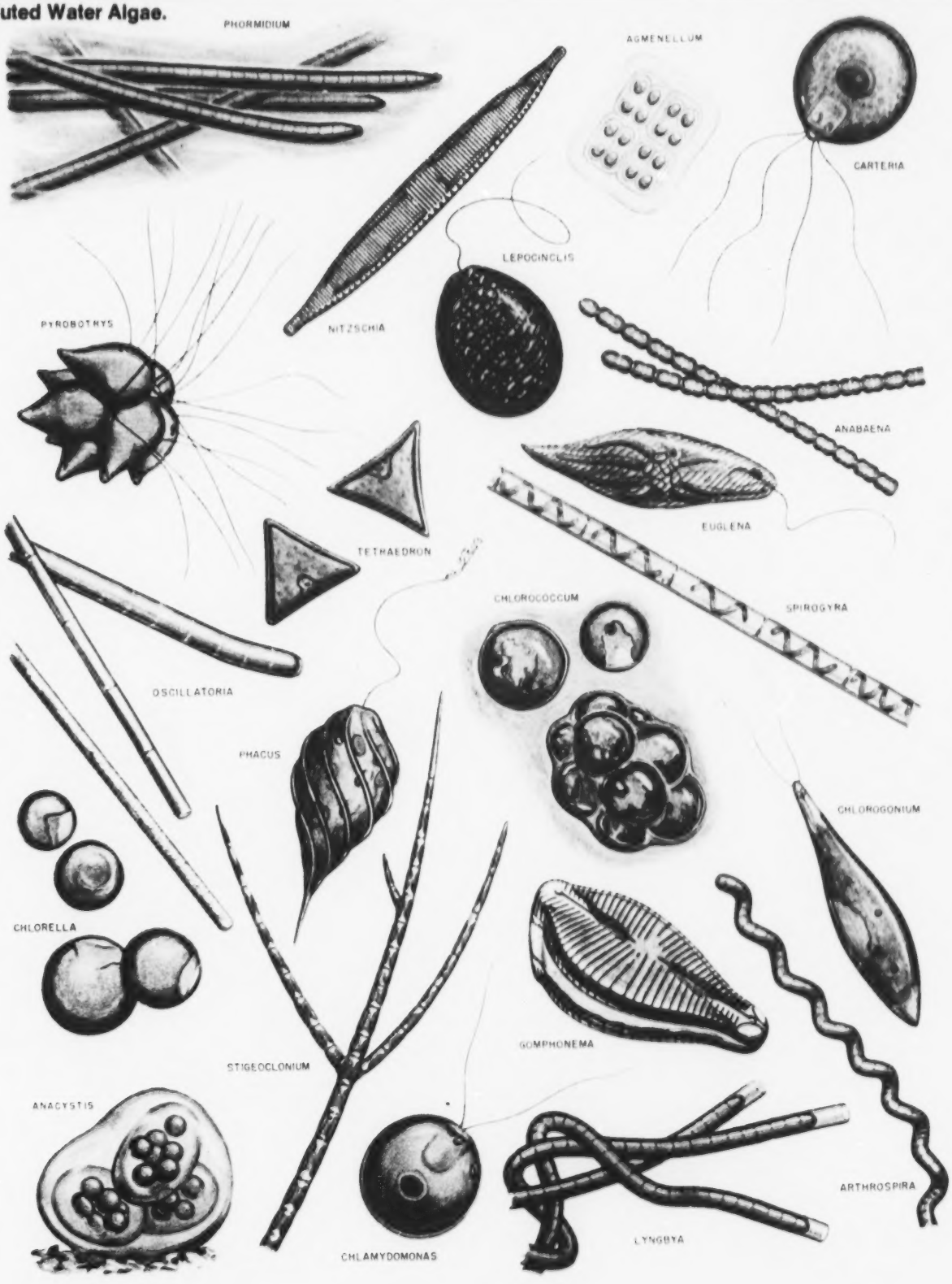


Figure B-4

Clean Water Algae.

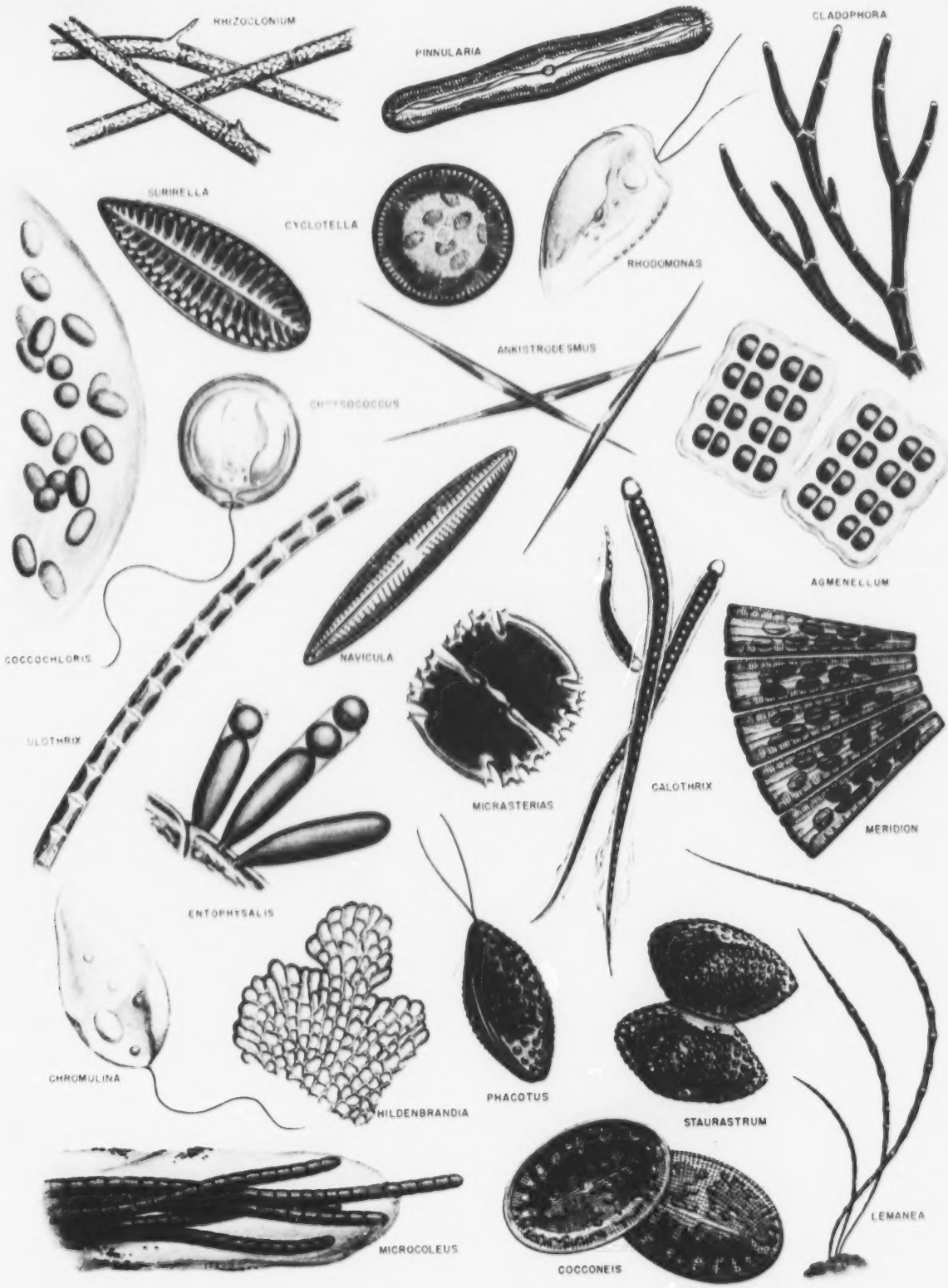


Table B-4.—Clean water algae

Species Names	Linear Magnifications
Agmenellum quadriduplicatum, glauca type	250
Ankistrodesmus falcatus var. acicularis	1000
Calothrix parietina	500
Chromulina rosanoffi	4000
Chrysococcus rufescens	4000
Cladophora glomerata	100
Coccochloris stagnina	1000
Cocconeis placentula	1000
Cyclotella bodanica	500
Entophysalis lemaniae	1500
Hildenbrandia rivularis	500
Lemanea annulata	1
Meridion circulare	1000
Micrasterias truncata	250
Microcoleus subtorulosus	500
Navicula gracilis	1000
Phacotus lenticularis	2000
Rinnularia nobilis	250
Rhizonclonium hieroglyphicum	250
Rhodomonas lacustris	3000
Staurastrum punctulatum	1000
Surirella splendida	500
Ulothrix aequalis	250

Table B-5.—Plankton and other surface water algae.

Species Names	Linear Magnifications
Actinastrum gracillimum	1000
Botryococcus braunii	1000
Coelastrum microporum	500
Cylindrospermum stagnale	250
Desmidium grevillei	250
Euastrum oblongum	500
Eudorina elegans	250
Euglena gracilis	1000
Fragilaria capucina	1000
Gomphosphaeria aponina	1500
Gonium pectorale	500
Micractinium pusillum	1000
Mougeotia scalaris	250
Nodularia spumigena	500
Oocystis borgei	1000
Pediastrum boryanum	125
Phacus pleuronectes	500
Scenedesmus quadricauda	1000
Sphaerocystis schroeteri	500
Stauroneis phoenicenteron	500
Stephanodiscus hantzschii	1000
Zygnema sterile	250

Table B-6.—Algae growing on reservoir walls.

Species Names	Linear Magnifications
Achnanthes microcephala	1500
Audouinella violacea	250
Batrachospermum moniliforme	3
Bulbochaete insignis	125
Chaetophora elegans	250
Chara globularis	4
Cladophora crispata	125
Compsopogon coeruleus	125
Cymbella prostrata	250
Draparnaldia glomerata	125
Gomphonema geminatum	250
Lyngbya lagerheimii	1000
Microspora amoena	250
Oedogonium suecicum	500
Phormidium uncinatum	250
Phytoconis botryoides	1000
Stigeoclonium lubricum	250
Tetraspora gelatinosa	125
Tolypothrix tenuis	500
Ulothrix zonata	250
Vaucheria sessilis	125

Figure B-5

Plankton and Other Surface Water Algae.

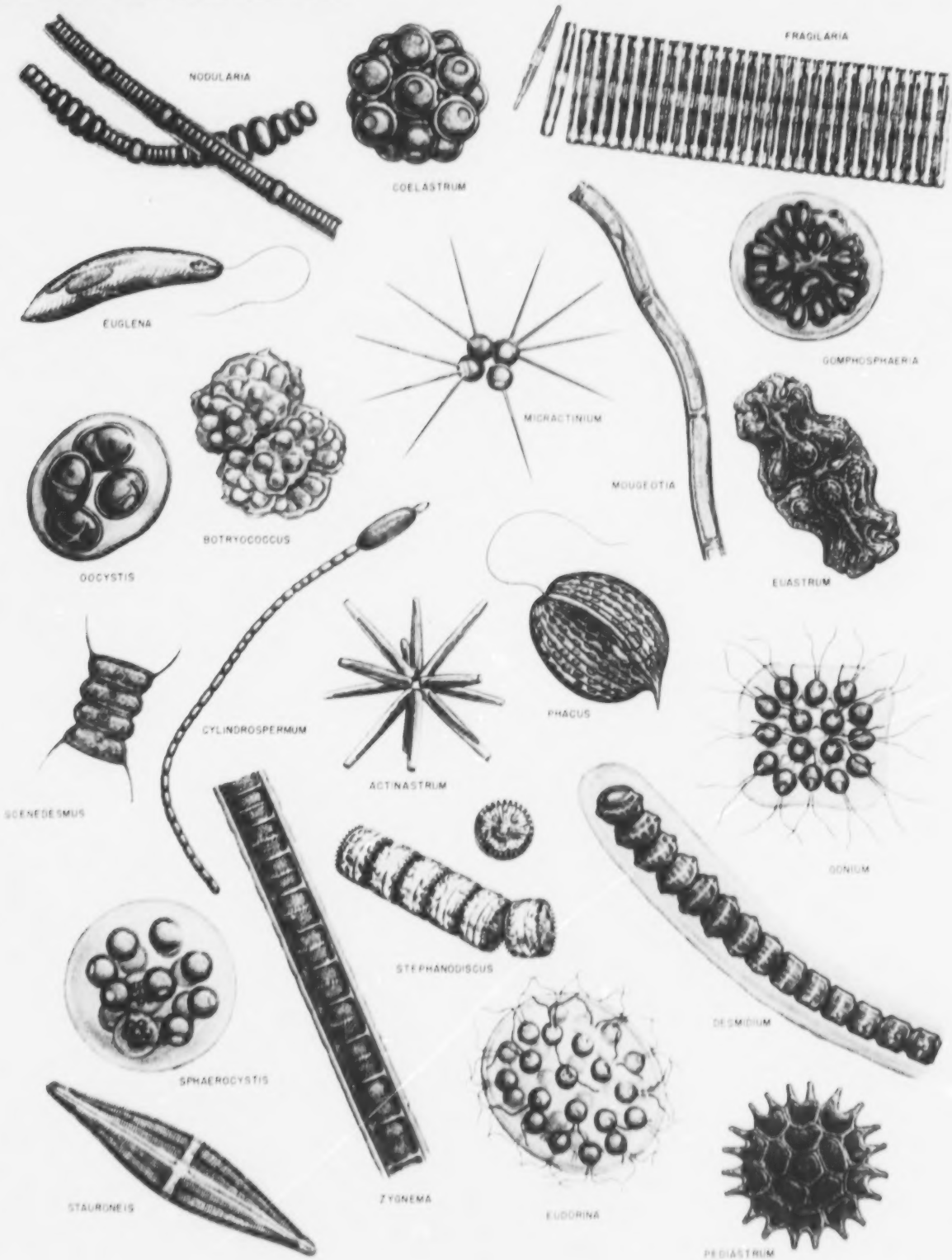


Figure B-6

Algae Growing on Reservoir Walls.

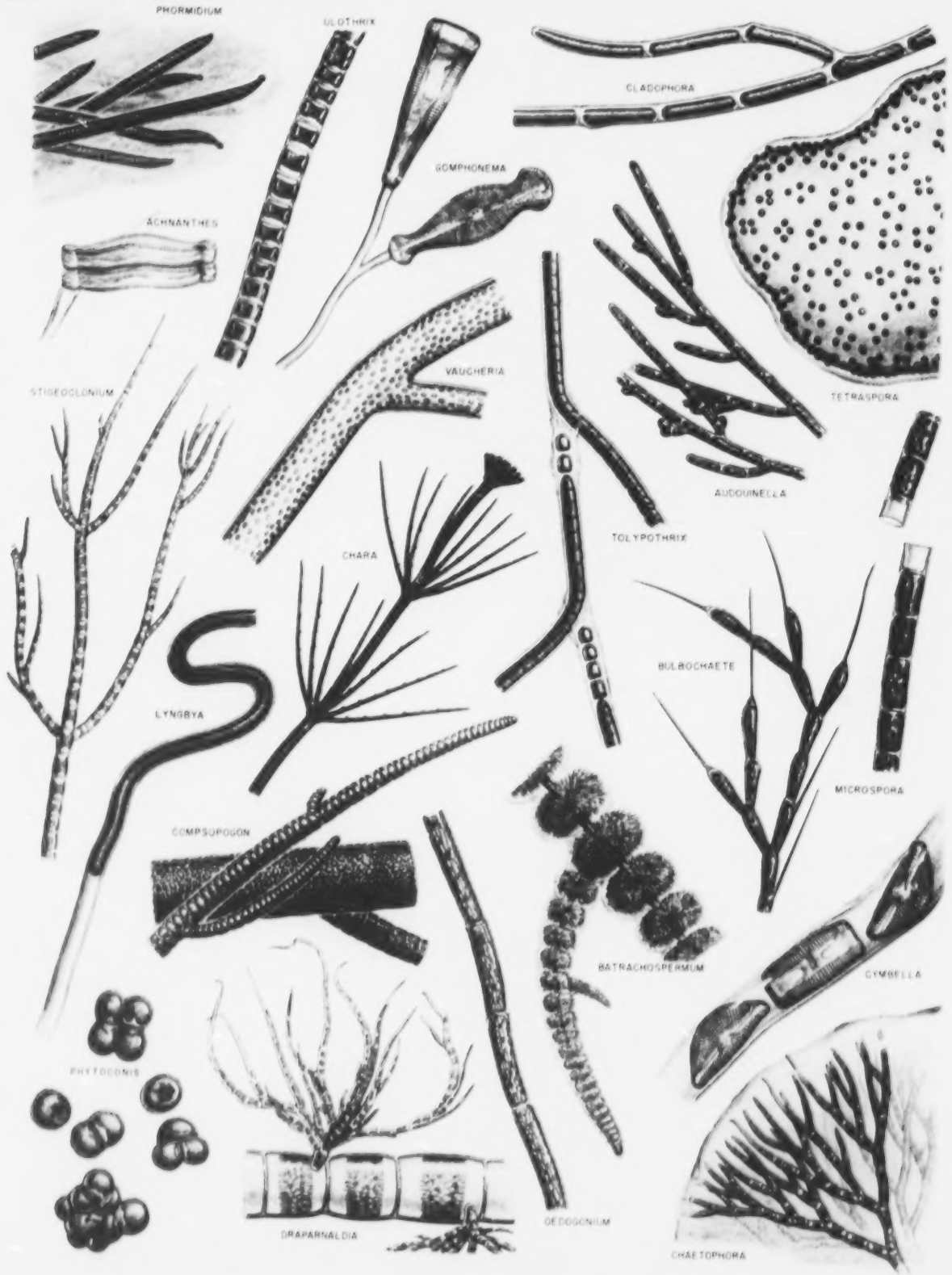
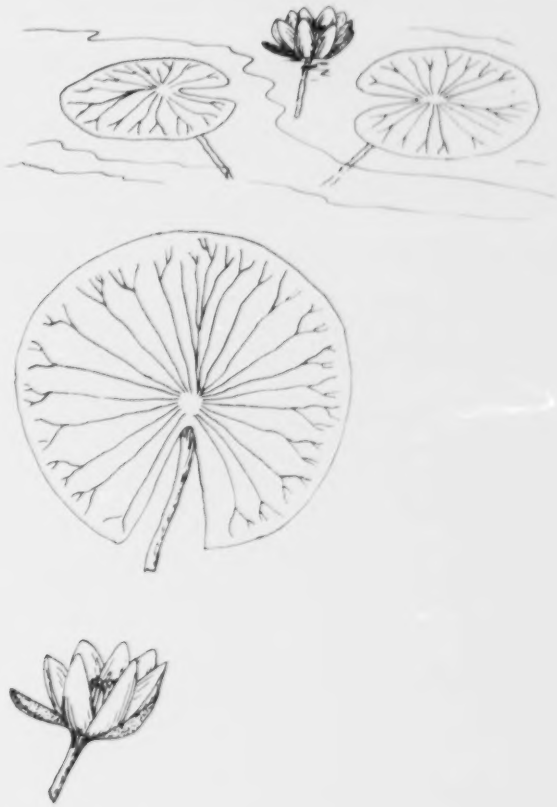


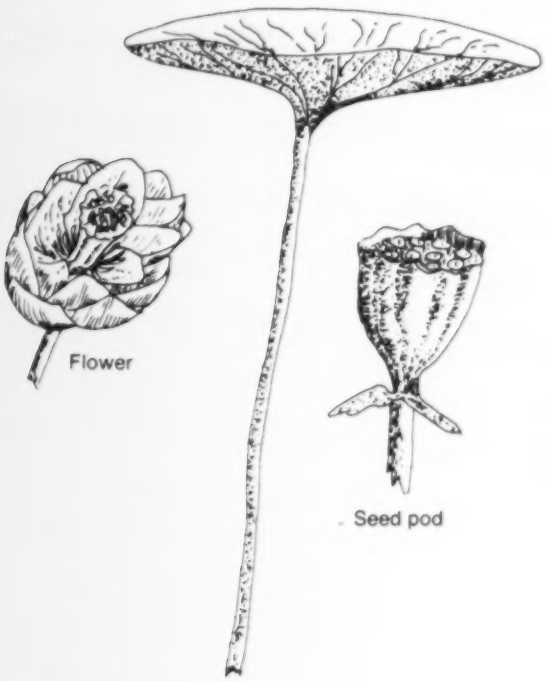
Figure B-7

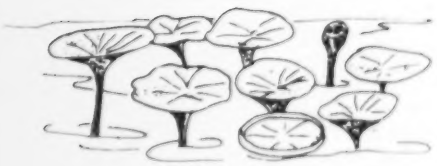
Types of Freshwater Algae.

Algal scums (various species) grow on the bottom or on and around objects. Later, they rise to the surface in large mats, whereupon they die and decay. Two forms are present, the branched form (upper) and the single filamentous (below). The branched form is green to grayish-green and coarse feeling like wet cotton. The single filament is slimy to the touch and green-to-brown in color.



Waterlily (*Nymphaea*)
The large, circular, waxy floating leaves are deeply notched and borne on tough, elastic stems. The large white, pink, yellow, or blue flowers, with 12–40 petals, float on the surface with the leaves. The thick inter-twining roots of this plant form extensive mats over the bottom.





Leaf and stem

Lotus

Leaves. Circular 12-24 in. in diameter, with the centers "cupped." Usually they stand up out of the water, but immature leaves lie flat on the surface.

Stem. 1/4 to 1/2 in. in diameter, stiff and upright.

Flowers. 4.5 to 10 in. in diameter, pale yellow in color.

Special characteristics. The large, cupped leaves which stand upright are distinctive and characteristic of no other native plant.

Watermilfoil (*Myriophyllum*)

Leaves. Upper aerial ones elliptical with scalloped edges, giving it a prickly appearance, and dark green in color. Late in summer they turn red. Submerged leaves much longer and wider. Finely divided, giving the leaves a feather-like appearance.

Stems. Thick, reddish to brown, hollow or loosely pith filled.

Special characteristics. The upper leaves of this plant projecting 3-5 inches above the surface of the pond make it easily identified and separated from Parrots Feather.

Habitat. Shallow water 0-5 ft. deep.

Figure B-7

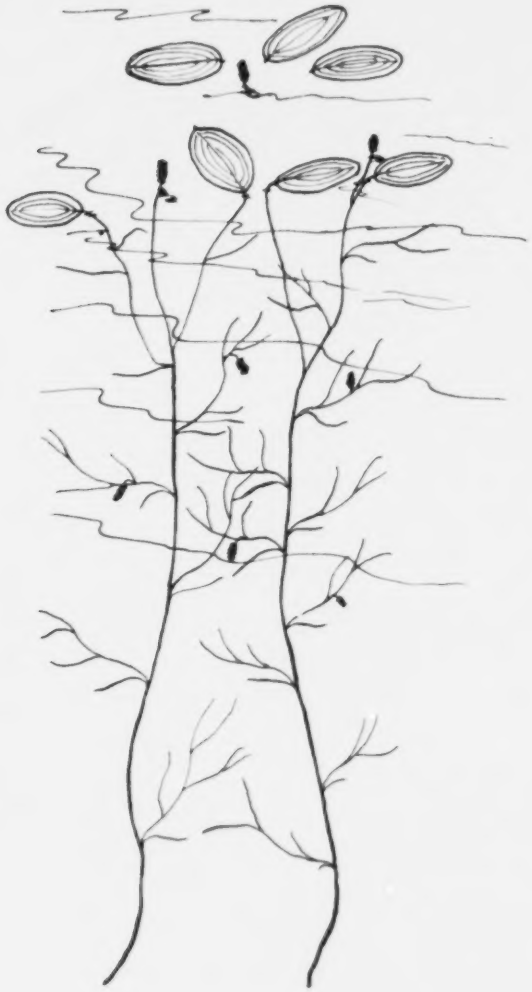
Continued.

Coontail (*Ceratophyllum*)
A submerged, brittle herb with leaves in whorls about the main stem, which is generally forked once to several times. The leaves are very fine and forked (sometimes divided into threes) at the tips. These "tiplets" have a "spiny" appearance because of their wavy margins. This plant is "rooted" in the spring and early summer and free-floating in the late summer and early fall. The seeds of this plant are taken by waterfowl.

Naiads (*Najas*)
Submerged herbs with opposite or whorled, narrow to thread-like leaves. The bases of the leaves sheathe the stem. The main stem is branched and has fibrous roots. The seeds are small and ellipitical and are found in the axil of the leaves. This plant is a favored food of many ducks.

Fanwort (*Cabomba*)
Delicate, branched, submerged herbs with finely divided leaves that are opposite or in whorls. Occasionally, the upper floating leaves are produced. These are small, oblong, and attached at the center of the blade. The flowers are small and have three white to yellow petals.

Figure B-7



Pond Weeds (*Potamogeton*)

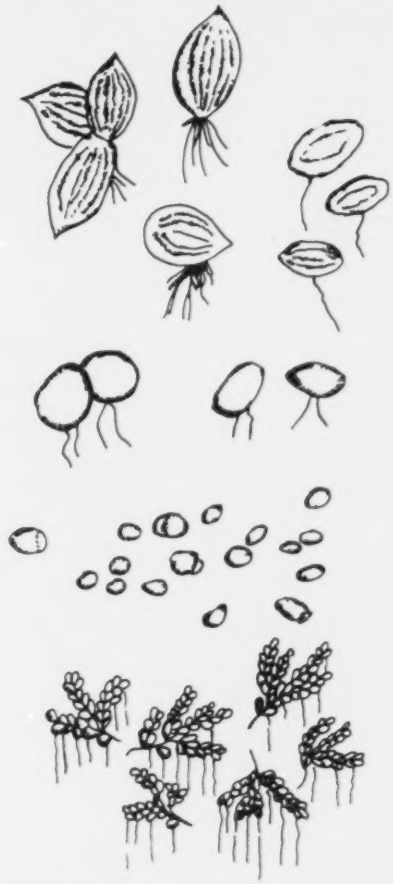
Leaves. Upper floating ones elliptical to oval, generally small (1/2-2 in). One species has very large leaves (3-10 in long). The surface is waxy. In some cases, the upper leaves may be missing. Lower leaves are very narrow, 1-2 mm (0.04-0.08 in) or less and strap-like.

Stems. Thin, but strong, varying in length, according to water depth. Always rooted.

Fruit. The small, cylindrical seed heads are on separate stalks, sometimes appearing above the water or generally found in the axil of the leaves. These seeds are avidly taken by ducks.

Special characteristics. The only plant having leaves this small floating on the surface of the water.

Habitat. Any body of water.



Free Floating Plants

Duckweeds, (*Lemna* and *Spirodela* spp.)
Small, 1-12 mm (0.04-4.7 in) long, free floating green plants of various shapes, generally oblong, that have one to many small rootlets hanging in the water and 1-15 "nerves" appearing on the top of the plants. *Spirodela* is larger and may be purple on the underside. These plants are 1-8 mm (0.04-0.3 in) long, oval in outline with a small pointed tip, have many rootlets, and have 5-11 "nerves" on the upperside. *Lemna* has 1-5 "nerves," one rootlet, and is green on the underside and smaller, being 1-5 mm (0.04-0.2 in). Under some conditions, these plants may have a reddish color. It would be best to check them to prevent confusion with water fern.

Duckmeal, (*Wolffia and Wolfella spp.*)
The tinest flowering plant in the world, 0.5-2mm (0.04-0.08 in) long, rootless, globular to ellipsoid in outline.

Waterfern (*Azolla sp.*)
Larger than the above, 0.5-1 cm (0.2-0.4 in) long, having small overlapping leaves borne on a once-to-several times forking stem. Several small roots hang in the water. At maturity these plants are red, rosy pink, or reddish brown. Young plants are green.

Figure B-7

Continued.

Elodea, or Waterweed (*Anacharis*)

Leaves. Narrow, gradually tapering to the tip. Borne either opposite each other in pairs, or in whorls of 4–5. Leaves of *E. densa* are large and coarse; those of the other two species smaller and more delicate.

Stems. Herbaceous, lax, and generally rooted; sometimes form floating mats.

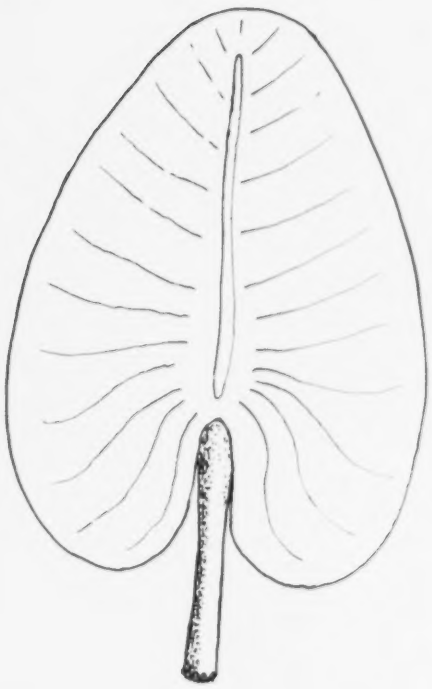
Flowers. Arise between the stem and leaves. Three petals are present, and these are white or pinkish. Mainly spreads vegetatively.

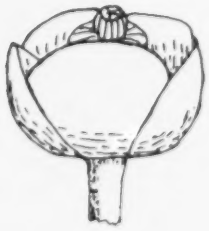
Special characteristics. These are the same plants sold in pet stores for use in aquariums. Perennial, does not die back in the winter.

Habitat. Shallow water of lakes or ponds.

Watershield (*Brasenia*)

The floating leaves are oval and the undersides reddish and covered with a shiny covering. The stems are usually covered with this coating also. The small flowers are reddish to purple and have 3–4 petals. Prefers ponds or slow-moving acid water with a sandy bottom. Some diving ducks readily take the seeds of this plant.





Spatterdock, Yellow Waterlily (*Nuphar*)
The large, waxy leaves are heart-shaped and may be upright or floating on the surface. The stems are thick, strong, and elastic. The small flowers are yellow and waxy in appearance. This plant is found in the shallows out to a depth of 3-4 feet.

Alligatorweed (*Alternanthera*)
May be found growing upright on damp soil or growing as a floating mat in water. Leaves roughly oval and opposite one another on the stem. The bases of the leaves merge to form a sheath which is slightly swollen. Leaves and stems succulent and fleshy. Flowers white and resemble the flowers of white clover. These are borne on a long stalk growing between the stem and leaf. Seeds are not viable, and this plant reproduces vegetatively from the nodes.

Carolina Watergrass (*Hydrochloa*)
Leaves small (1-2 in long *x* 1/4 in wide), elliptical, grayish-green to green in color. These are found mainly towards the end of the stem and float on the surface. This plant can be found growing next to the shore or in shallow water. May form floating mats which can cover up small ponds. Rarely fruits.

Figure B-7

Continued.

Smartweeds, Water Pepper (*Polygonum*) Plants inhabiting the shallow water of a pond, with lance-shaped, alternate leaves. At the base of each leaf is a sheath going around the stem and topped with long, fine hairs. The flowers are pink, white, or greenish and found in terminal spikes or on short, lateral spikes originating between the leaf and the stem. The seed is either triangular or lens-shaped in cross-section. These seeds are a choice food for ducks.

Lizardstail (*Saururus*)
Succulent herbs with jointed stems and alternate drooping heart-shaped leaves, found along the edges of the water. The long, nodding, white-flowered spike is present during the summer and easily distinguishes this plant.

Cattail (*Typha*)
Long, narrow, veinless, bluish-green leaves, sheathing at the base of the plant, and the familiar seed head are enough to identify this plant.

Arrow-arum (*Peltandra*) - Upper Left
The leaves are shaped like a barbed arrowhead and are borne on thick fleshy stems. The yellow "flowers" are enclosed in a green, partly opened, sac-like structure which terminates in a wrinkled tip. The skin of the fruit is green, purplish, or brown, and the seeds are enclosed in a gelatinous mass within the fruit.

Arrowhead (*Sagittaria*) - Upper Right
The leaves are highly variable, but are generally arrowhead-shaped, though the "barbs" may or may not be present, according to the species and water depth. The small white flowers are in whorls of three along the main stalk.

Pickerelweed (*Pontederia*) - Lower Left
The leaves are heart-shaped and are borne on thick stems. The flowers are bluish and found in a terminal spike.

Note: In the case where the flowers are absent, these plants may be differentiated by the veination of the leaves. See the illustration.

Figure B-7

Stoneworts Muskgrass (*Chara*)

Actually a higher form of perennial algae. The 6–12 leaves are cylindrical and arranged in whorls around the stems and branches. Stems, branches, and leaves are very brittle, and when crushed, emit a strong musk-like or "skunky" odor. The "fruit" or *oogonium* appears as small black dots scattered over the leaves of the plant. Variable in height but generally not reaching the surface of the water. All parts of the plant are eaten by waterfowl.

Simple assessment of bottom-dwelling insects (ref. A-2).

Immature forms of bottom-dwelling stream insects live primarily in riffles—shallow, swift-flowing portions of a watercourse. Two major groups of aquatic insects should be present in the upper watercourse reaches of all unpolluted waterways: mayflies (fig. B-8) and caddisflies (fig. B-9). Mayflies have a roachlike body, a thin hairlike tail, and six jointed legs. Caddisflies have a maggotlike body, no tail, and six jointed legs.

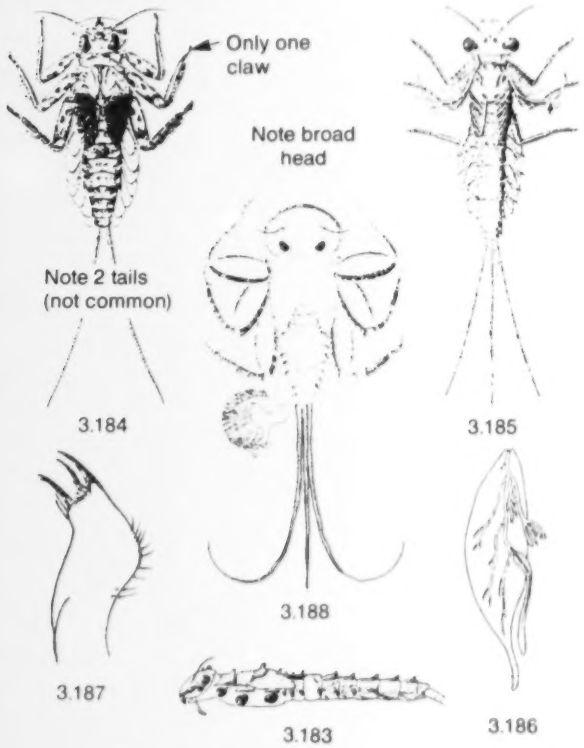
To sample these insects, use the following simple technique. Remove three stones from a shallow, swift-flowing portion of the watercourse. Each stone should be about six inches in diameter. Place the stones in a bucket filled with stream water. Brush the entire surface of each stone with your hands. If after carefully examining the surface of each, you are satisfied that no insects remain, then discard the stone. Pour the contents of the bucket through a white handkerchief. Count the number of mayflies and caddisflies. Using the following illustrations, identify and count the number of insects belonging to the various groups.

If both mayflies and caddisflies are absent from the watercourse, then the watercourse is severely polluted. If only mayflies *or* caddisflies are present, then the watercourse is probably moderately polluted. If both mayflies and caddisflies are present, along with stoneflies (fig. B-10), then the stream is probably in good-to-excellent condition. Stoneflies resemble mayflies in having a roachlike body, tail, and six jointed legs. Mayfly legs come to a fine point at the tips, whereas stonefly legs are tipped with two hooks or claws.

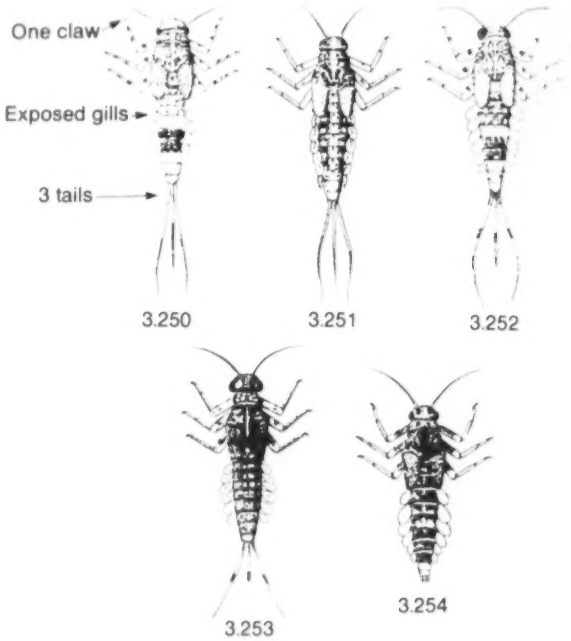
Insect larvae, which are tolerant of pollution and might be found in either clean or moderately polluted water, are blackflies, bloodworm midges (chironomids), rat-tailed maggots, and others. See also fig. A-4.

Figure B-8

Mayflies *(Ephemeroptea).*



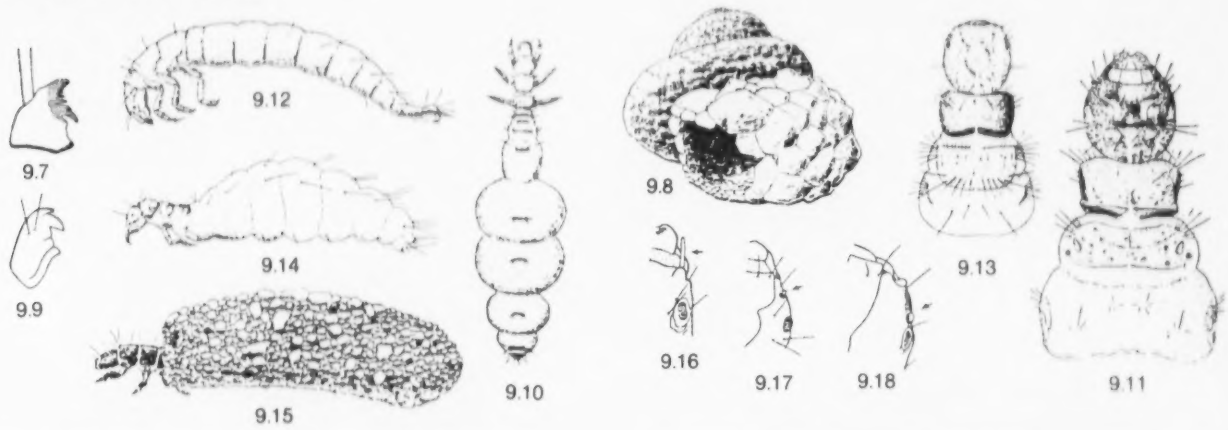
Figures 3.183 through 3.188. *Heptageniidae*. 3.183 *Spinadis*, lateral aspect (shown without legs and gills); nymph, dorsal aspect: 3.184 *Epeorus*, 3.185 *Arthroplea bipunctata;* 3.186 *Pseudiron*, gill of 3rd abdominal segment; *Anepeorus:* 3.187 mandible, 3.188 dorsal aspect and left abdominal gill (3.183 after Flowers and Hilsenhoff 1975; 3.184 through 3.186, 3.188, Illinois Natural History Survey, (INHS)).



Figures 3.250 through 3.254. *Baetidae*. *Baetis* nymph, dorsal aspect: 3.250 *B. macdunnoughi*, 3.251 *B. pygmaeus*, 3.252 *B. intercalaris*, 3.253 *B. propinquus*, 3.254 *B. tricaudatus* (all after Morihara and McCafferty, 1979).

Figure B-9

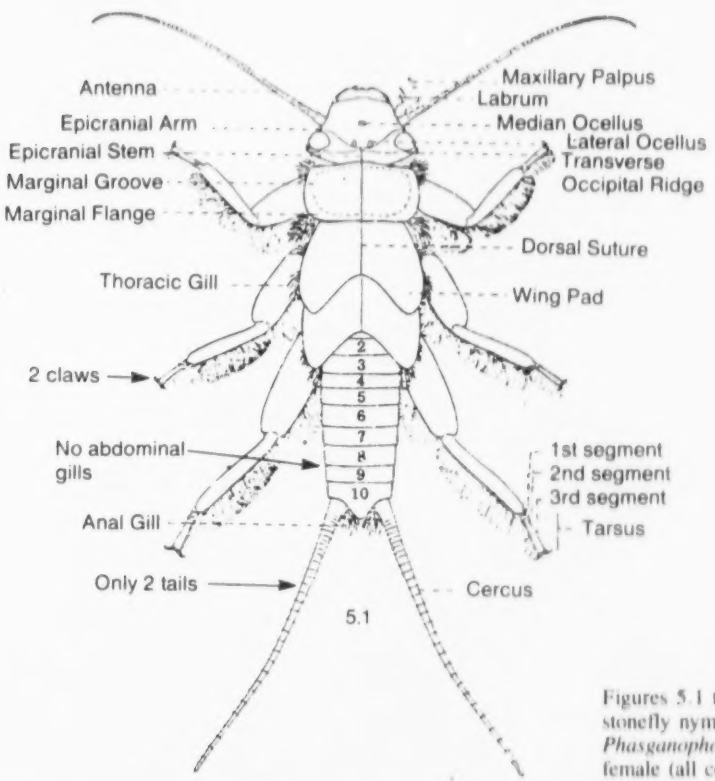
Caddisflies *(Tricoptera).*

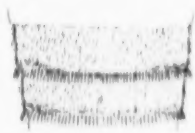


Figures 9.7 through 9.18. Family characters. *Helicopsyche borealis* larva: 9.7 anal claw, lateral aspect, 9.8 larval case; 9.9 *Brachycentrus*, anal claw of larva, lateral aspect; 9.10 *Leucotrichia pictipes* larva, dorsal aspect; 9.11 *Limnephilus submonilifer*, head and thorax of larva, dorsal aspect; 9.12 *Polycentropus* larva, lateral aspect; 9.13 *Lepidostoma*, head and thorax of larva, dorsal aspect; 9.14 *Hydroptila* larva, lateral aspect; 9.15 *Ochrotrichia* larva in purse case, lateral aspect; larval head, dorsal aspect: 9.16 *Leptocerus americanus*, 9.17 *Limnephilus*, 9.18 *Lepidostoma* (all INHS).

Figure B-10

Stoneflies *(Plecoptera).*



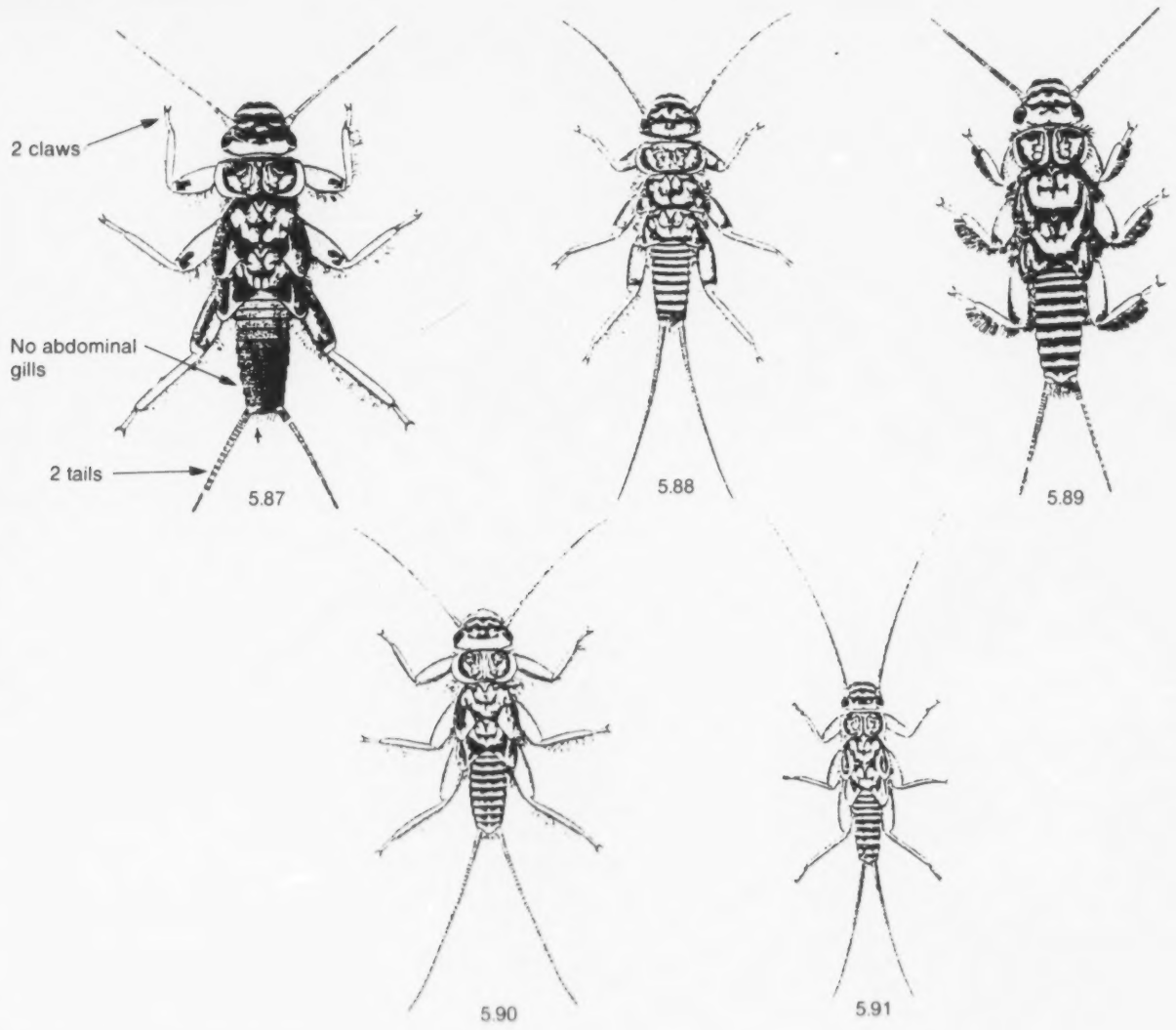

5.2

5.3

Figures 5.1 through 5.3. Stonefly structure. 5.1 generalized stonefly nymph, dorsal aspect. Abdominal segments 8 and 9 of *Phasganophora capitata* nymphs, ventral aspect: 5.2 male, 5.3 female (all courtesy of the INHS).

Figure B-10

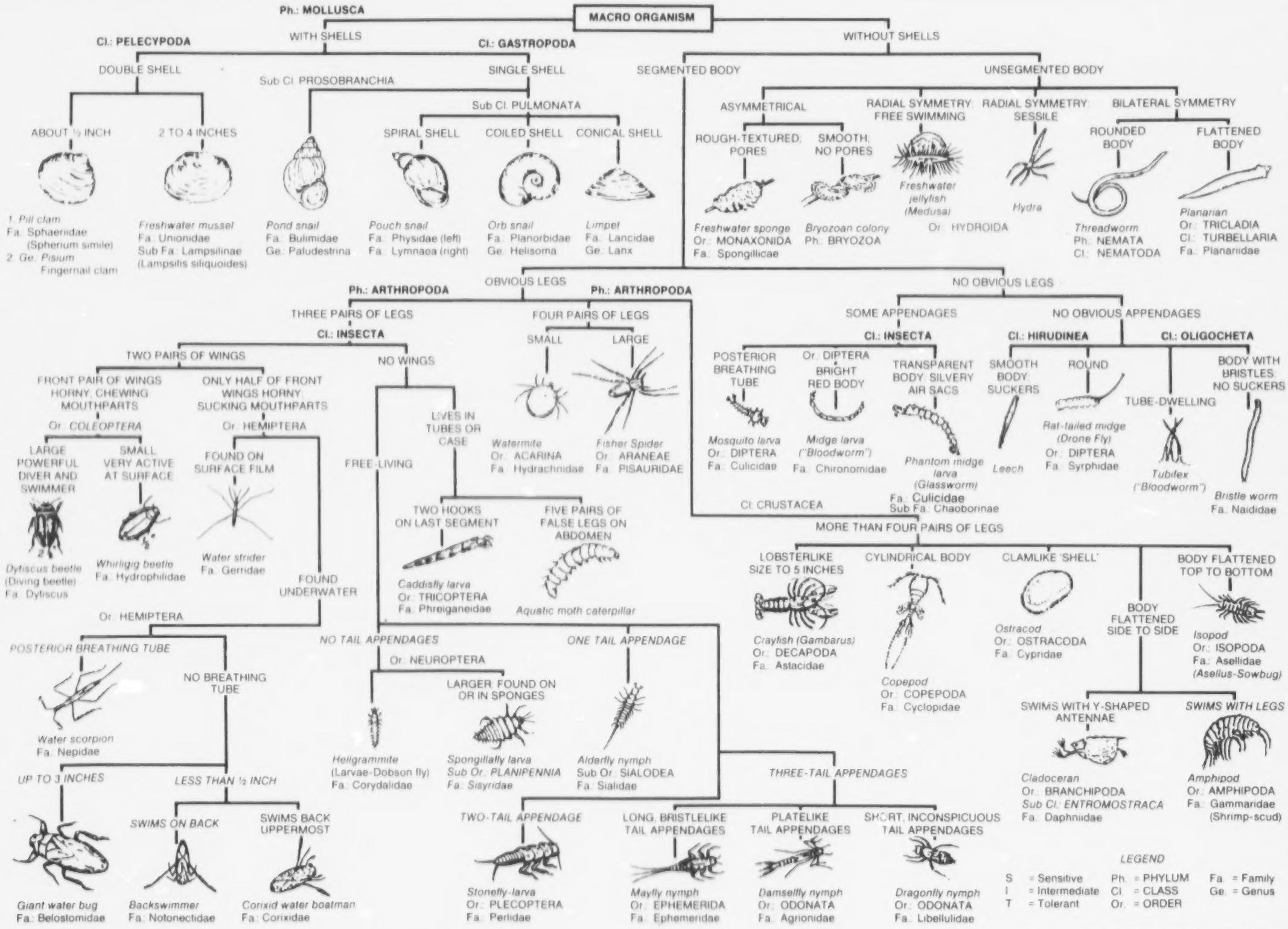
Stoneflies, continued.



Figures 5.87 through 5.91. *Perlidae. Acroneuria* nymph, dorsal aspect: 5.87 *A. mela*, 5.88 *A. lycorias*, 5.89 *A. evoluta*, 5.980 *A. perplexa*, 5.91 *A. filicis* (all INHS).

Figure B-11

Key to the Major Invertebrate Species of Stream Zones.



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5H

5H A

FARMING WETLANDS
STUDENT PAGE

Weather Condition _____

My Crop is _____

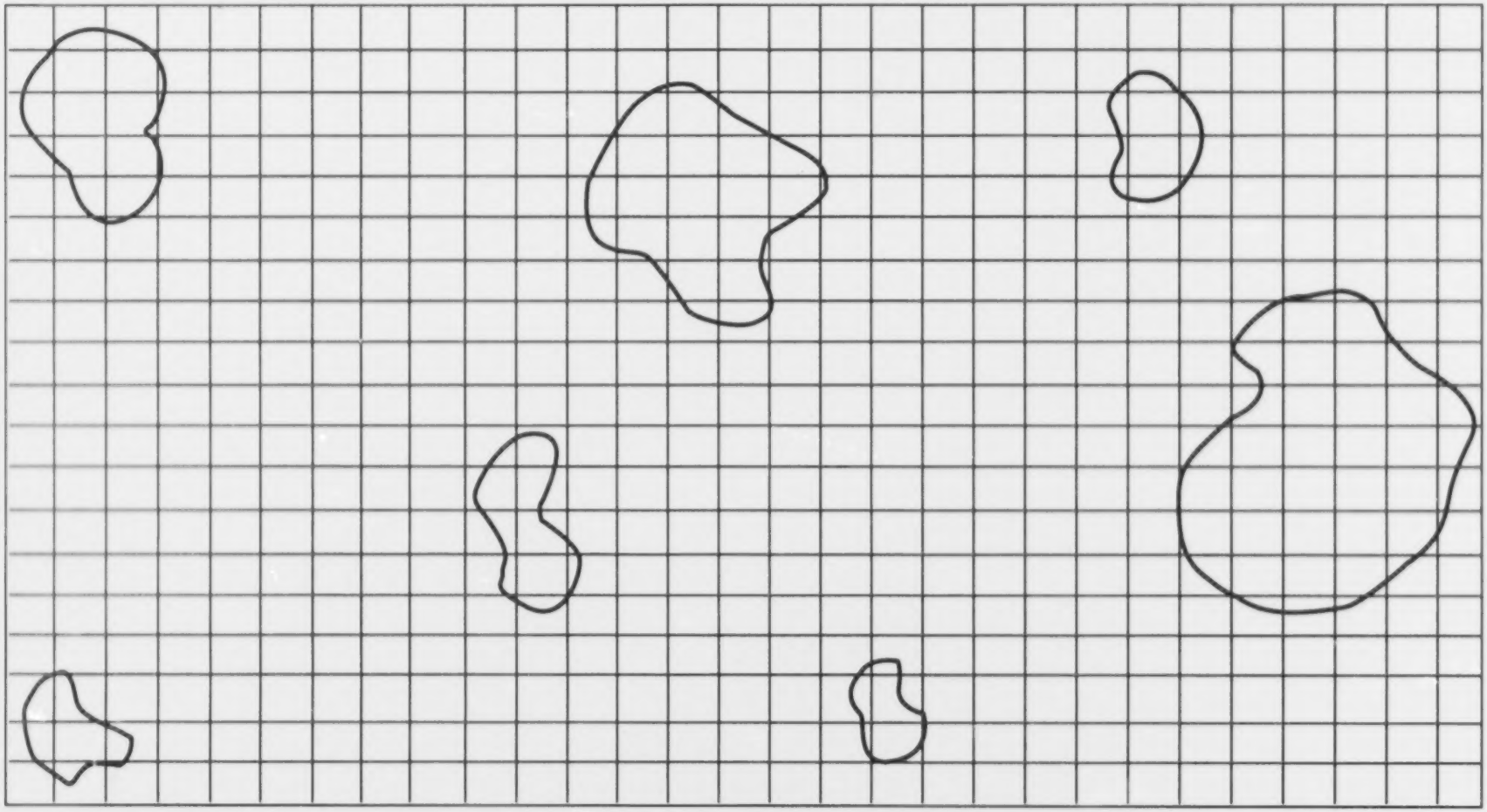
Net Profit per acre _____

Total field acres _____

Total non-cropped acres _____
Total hayed wetland acres _____
Total cropped wetland acres _____

Field Net Profit - cropped land _____
Field Net Profit - hayed wetlands _____
Field Net Profit - cropped wetlands

Total Net Field Profit _____



WETLANDS JEOPARDY

Wetland Terms	Functions	Wetland Community	Potpourri
10 pts.	10 pts.	10 pts.	10 pts.
Three characteristics that define what is a wetland.	Wetlands help improve the quality of this resource that is used by all living creatures.	A common wetland plant with a brown top that is eaten by muskrats.	Type of soil that loves water.
20 pts.	20 pts.	20 pts.	20 pts.
Another name for North Dakota wetlands.	Wetlands help protect humans and property against this kind of natural disaster.	Generic name for insects without backbones found in wetlands.	A wetland grass that is excellent for hay production.
30 pts.	30 pts.	30 pts.	30 pts.
Geological process that formed North Dakota's prairie wetland landscape.	Wetlands provide critical habitat for these migratory birds.	Three factors limiting survival of migratory bird populations.	The type of wetlands commonly used by muskrats.
40 pts.	40 pts.	40 pts.	40 pts.
Term for the geographical area of North Dakota where the largest number and area of wetlands is found.	Wetland plants help sift these substances out of the water.	An animal uses this coloration or behavioral techniques to enhance their survival.	The name of the area from which wetlands receive its water supply.

WETLAND HOP